THE MARINE REVIEW

VOL. 45 CLEVELAND JUNE, 1915 NEW YORK No. 6

Merchant Marine Oddities

The Manx Trading Boats, Picturesque Little Fishing Craft —The Immensity of the Port of London—Its River Craft

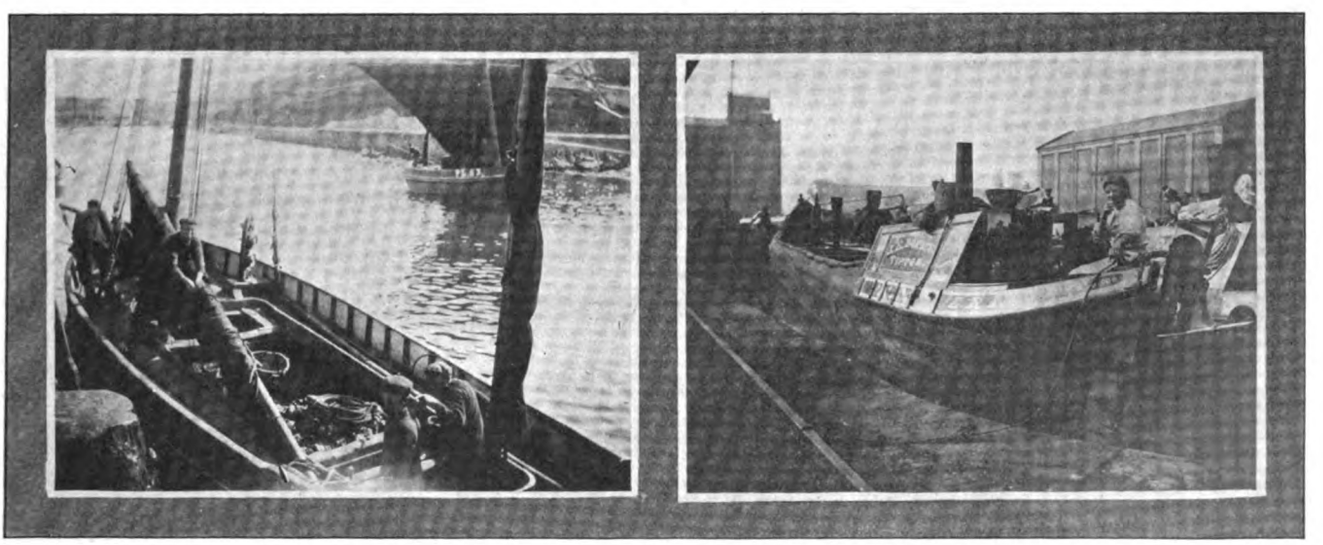
By Felix J Koch

TIME out of mind, obviously, Britannia has ruled the waves, and British shipping, mercantile and otherwise, has been a subject literally "done to death" by writers upon such themes; but even the best informed officer of the British merchant service is forced to confess, now and then, that right back in "home waters", so to speak, there are phases of shipping, humble traders, or else units of a well-organized industry, of which he happens to have known next to nothing at all.

Just for example, there's the fleet of little Manx trading boats, plying from place to place on the Isle of Man and carrying such produce as the little railway of the island does not bring in, or which it is too far to transport otherwise from Douglass, where the big steamers stop.

Many of these vessels are normally fishing-craft, and when trade is otherwise dull, they turn to the older one of commercial fishing. The bit of inlet just next the famous old castle at Peel is a favorite anchorage for these boats, picturesque little fishing smacks, the mast at each end, the big gaping-hole to the hold between these, rigging, tackle, a fish trap or two set between and along the side, perhaps, a spare sail. Staunch, indeed, are these vessels; they have to be, for the storms that come up at times on the seas are not to be laughed at.

More than this, the skippers have their art bred in the bone, so to say, and they are ready to meet any gale. These Manxmen, in fact, are strangely other folk from the Manxmen one reads of in story. They are sturdy, wide awake, up-to-date men, who know their craft A to Z, and who, far from chattering together in the old Manx, speak the King's English as you'll hear this in any British port.



MANX CRAFT

WATER GYPSIES

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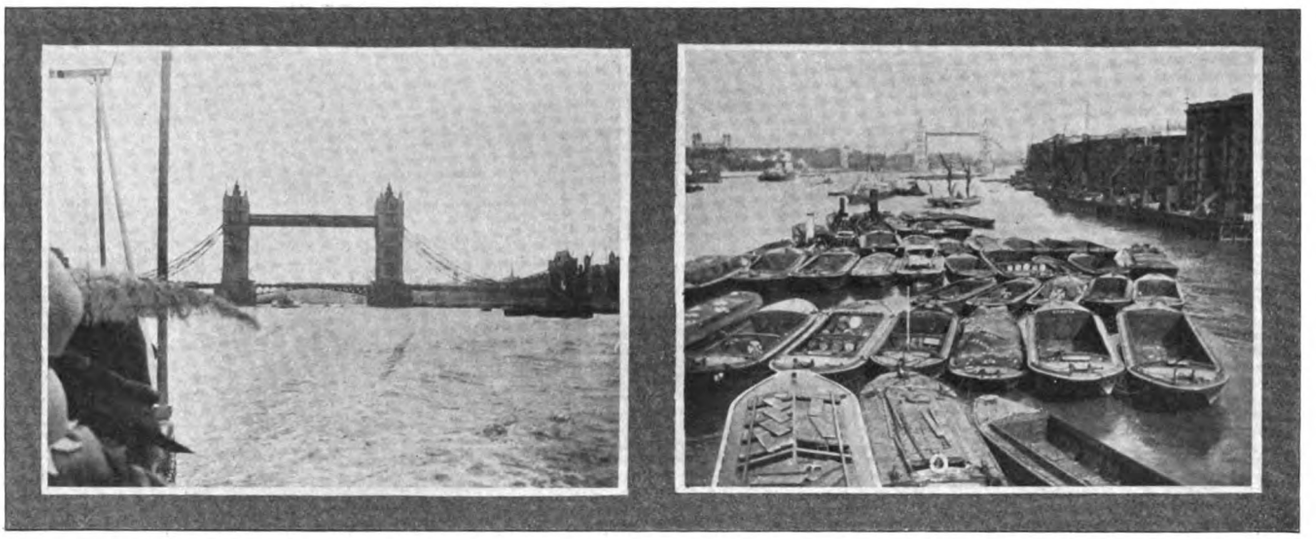


THE THAMES, LONDON—TOWER BRIDGE

BOATS OF PRODUCE, LONDON

Nearer home even than Manxland there are phases of the merchant marine which the sea-going mariner perhaps but seldom encounters. These are what Jack Roosa, in the cant of the region, speaks of with contempt as the "water gypsies".

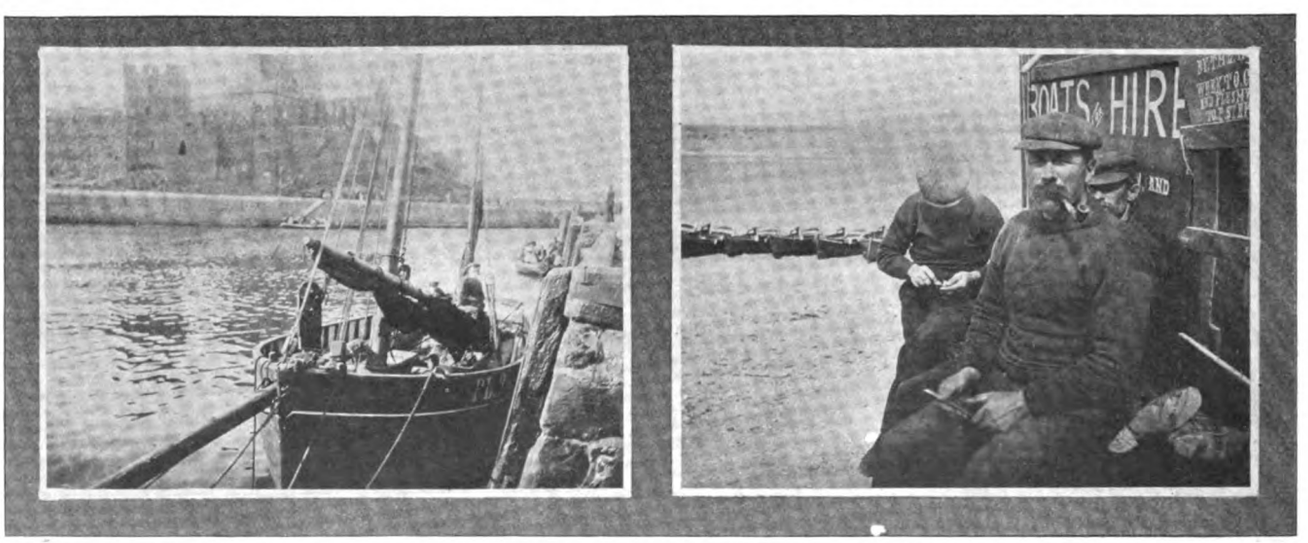
'Cross the seas in America the "water gypsies" would be classed with the merchant mariners operating the old style canal boats. In England, particularly as one sees them at Chester, they are a folk who operate low, sluggish craft, that serves wonderfully well to transport slow freight, and, all considered, make pretty good time. As a rule, on these boats of the "water gypsies" the skipper's entire family makes its home; they live as they go, and when times are hard they accept just about whatever they can get for their work. In fact, if the truth were told, many of these water gypsies have little incentive beyond earning enough to keep body and soul together and purchase the wherewithal to operate their craft, and when that much is assured, why bother? It's far pleasanter to just traverse the streams, the canals, whatsoever, living as Romany loves to!

Nevertheless, on the waterways where they're found, these water gypsies are actual factors in commerce and enter directly into the calculations of the shippers of the town.

It's a triteism—old as the hills, of course—that half the world doesn't know how the other half lives, and even as among officers of the merchant service it is found that many men spend their lives plying given routes, certain seas, and know next to nothing, as the result, of other ports than their own.

Thus, though one would scarce believe the statement at the mention, there are hundreds, thousands, of intelligent British seamen who have not visited London, studied it as a port, since perhaps the days of their first apprenticeship to the sea, if even then. Wherefor, come to London town and meeting the newsboys with their broadsides announcing a shipping crisis in Albion, and viewing the avidity with which the Londoner buys the papers just to devour the latest bits of news on this head, makes the newcomer realize as never before that London itself is a port of renown and that a peep at its shipping is quite worth the while. In fact, no officer or seaman of the merchant service of any land can come far amiss when on furlough between trips in England, of running down to London and rambling the Thames down along the city docks. The army of mariners encountered here gives a new notion of the importance of London as a port. The magnificent lift bridge, too, erected to make possible the passage of ships so far as this is another key to the importance of the place from this standpoint.

That London is other than a delivering place for the low, flat barges that



MANX FISHING BOATS

MANX SKIPPERS

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the tourist sees lying off the river, laden with produce as he makes the Sunday excursion to Greenwich is very soon sent home. One who knows the port of London best tells us some interesting facts anent the place.

"The port of London," he says, "beginning officially at Teddington Lock but practically at London Bridge, extends to the mouth of the Thames opposite the Isle of Sheppy, and is actually occupied by shipping nearly all the way to Tilbury docks. About one-fifth of the total shipping annually entering the United Kingdom enters London. The imports of London are about one-third and the exports about one-fourth of the total of the kingdom.

"Immediately below London Bridge begins the pool, which is held to end at Limehouse basin. Ships bearing the produce of every nation under the sun here discharge their cargoes, which, previous to sale, are stored, subject to customs, in large bonded warehouses, mostly in the docks. Below these warehouses, which form small towns of themselves and extend in long rows along the banks of the Thames, are extensive cellars for wine, oil, etc., while above ground are huge magazines, landing stages, packing yards, cranes and every kind of apparatus necessary for loading, unloading and custody of goods. The docks have hitherto been owned by various private stock companies.

"Some size of the magnitude of these docks is given by concrete figures. To the east of the tower, for one, and separated from it by a single street are the St. Katherine docks, opened in 1828 and covering an area of 23 acres, on which 1,250 houses with 11,300 inhabitants formerly stood. The engineer was the great Telford and the architect, Hardwick. The docks admit vessels up to 250 feet in length and 24 feet draught, while the warehouses from latest figures obtainable will hold 110,000 tons of goods. St. Katherine's steamboat wharf, adjoining the docks, is used mainly as a landing stage for steamers from the continent.

London Docks

"London docks themselves, off to the east of St. Katherine's docks, were constructed in 1805 at a cost of £400,000 and cover an area of 100 acres. They have three entrances from the Thames and contain water room for about 400 vessels, exclusive of lighters. Their warehouses can store from 170,000 to 260,000 tons of goods, according to description, and their cellars 121,000 pipes of wine. At times upwards of 3,000 men are employed at these docks in one day. Every morning at 6 o'clock there may be seen waiting at the principal entrance a large and motley crowd of laborers, to which numerous dusky visages and foreign costumes impart a curious and picturesque air. The door in the east angle of the docks, To the Kiln, informant tells us, leads to a furnace in which adulterated tea and tobacco, spurious gold and silver wares and other confiscated goods used to be burned. The long chimney is jestingly called the 'King's Tobacco Pipe'."

A leading compiler of cicerones speaks as follows of the London docks:

"Nothing will convey to the stranger a better idea of the vast and stupendous wealth of London than a visit to these warehouses, filled to overflowing with interminable stores of every kind of foreign and colonial products; to these enormous vaults, with their apparently inexhaustible quantities of wine and to these extensive quays and landing stages, cumbered with huge stacks of hides, heaps of bales and long rows of casks.

"The public are freely admitted to the quays, but visitors should be on guard against accidents from the working operations always going on at the docks.

"Access to the warehouses and sheds is limited to persons having business there. Those who wish to taste the wines must procure a tasting order, as it is called, from a wine merchant"; and the solicitous guide to the London docks concludes with the note that "visitors should beware of the insidious effects of tasting in the heavy vinous atmosphere!"

New Argentine Battleship

The Moreno is a First-Class Fighting Craft Having a Formidable Battery and High Speed—Driven by Curtis Turbines

THE Argentine battleship Moreno recently completed by the New York Ship Building Co., Camden, N. J., for the Argentine Republic is of the following dimensions:

Length, over all	594 ft. 9 in.
Breadth	98 ft. 0 in.
Depth, to upper deck	42 ft. 0 in.
Normal load draught	27 ft. 7 in.
Displacement	28,000 tons

The protection consists of a main belt of armor 12 inches thick, for about 250 feet amidships, and 10 inches thick to the forward and after 12-inch turrets. This armor extends from 5 feet 11 inches above, to 3 feet 3½ inches below the water line, at normal thickness, and then tapers to a thickness of 5 inches at 5 feet 11 inches below the water line. The belt armor forward of the forward 12-inch turret reduces to 6 inches and 5 inches and that aft of the after 12-inch turret, to 4 inches. Above the main belt, the armor is 9 inches thick at the bottom, tapering to 8 inches at the upper deck, from the forward to the after 12-inch turrets, reducing to 5 inches and 4 inches forward. Transverse armor of 8 inches and 6 inches thickness is fitted at the ends of the 10-inch main belt, connecting to the forward and after barbettes. On the upper deck is built the citadel of 6-inch armor, extending from the forward 12-inch turret to the after amidship 12-inch turret, in which are mounted twelve 6-inch guns. The barbette is 9 inches thick above the level of the belt armor, and 3 inches thick below.

The forward conning tower is of 12-inch and the aft one of 9-inch armor. On top of the conning towers are mounted fire control turrets of 8-inch and 7-inch armor. Amidships, are located two secondary fire control towers of 6-inch armor, on which are mounted tubular masts. These masts are connected by a bridge, and support platforms for searchlights. To them are also connected the cranes for raising and lowering the small boats carried on the superstructure deck.

Further protection is afforded by nickel steel decks and bulkheads, while the magazines, boiler and engine rooms are protected from torpedoes and mines by nickel steel decks and bulkheads, which, with the inner bottom and outer shell, form a third skin to the vessel.

Additional protection against torpedoes is afforded by a torpedo net, covering practically the entire length of the vessel.

The main battery consists of twelve 12-inch guns, of 50 calibres, mounted in pairs in six turrets. The turrets are located two on the center line at the bow, one on the starboard side just forward of amidships, one on the port side just aft of amidships, and two on the

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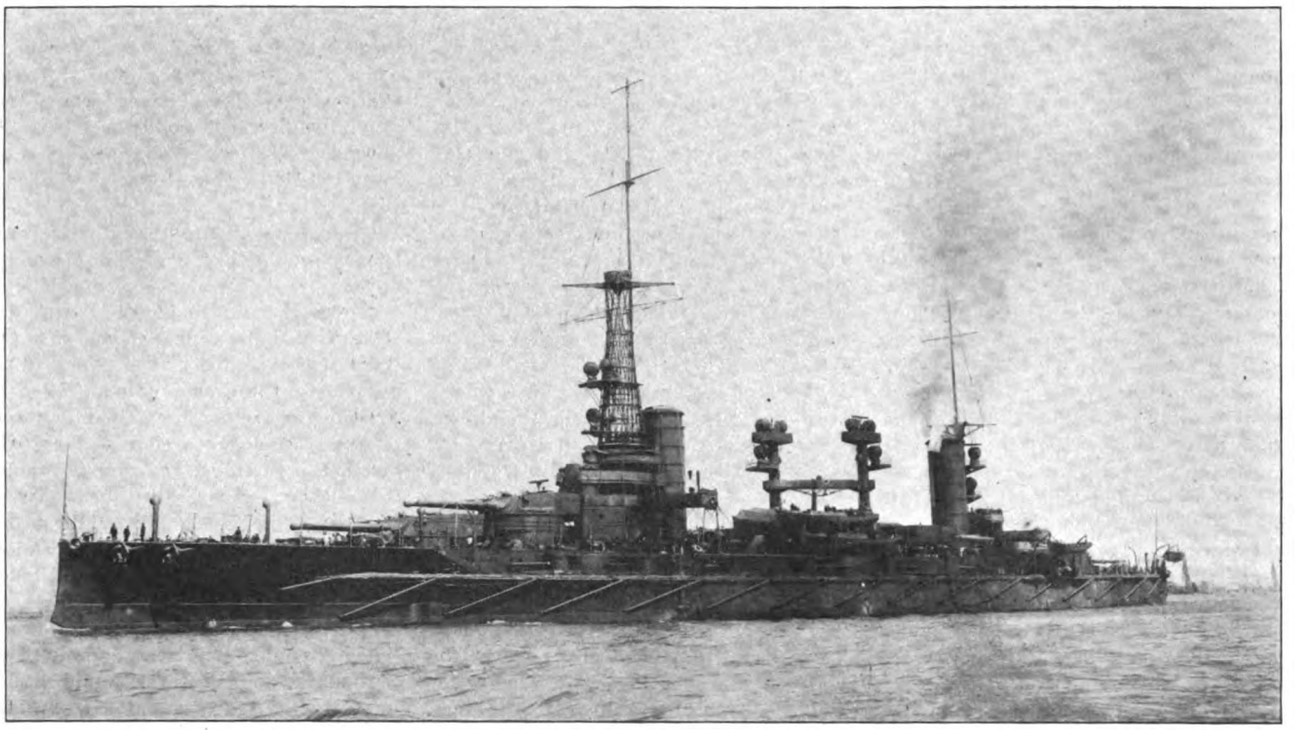

ARGENTINE BATTLESHIP MORENO LEAVING FOR HAMPTON ROADS
Photo by New York Ship Building Co.

center-line at the stern. The guns in the forward upper turret are 39 feet 5 inches above the water line, those in the after most turret 23 feet 8 inches, and all the others 31 feet 6 inches.

The secondary battery consists of twelve 6-inch guns, mounted in the citadel on the upper deck.

Twelve 4-inch guns, for defense against torpedo attack, are distributed four forward, four amidships, and four aft on the upper and superstructure decks.

Two submerged 21-inch torpedo tubes, disposed one on each side, port and starboard, are located in the forward part of the ship.

The magazines are fitted with mechanical refrigeration.

The forward mast is of the United States navy type of pyramid mast, and the after mast is of the ordinary pole type. The masts are equipped with searchlight platforms, and support the aerials for wireless communication.

Three Curtis turbines, aggregating 40,000 horsepower, driving three propellers, developed a speed of 22.69 knots per hour on the trial, which took place in November, 1914. A speed of over 22.5 knots was maintained for eight hours.

The engines are located amidships, each in a separate compartment.

There are eighteen Babcock & Wilcox boilers in six watertight compartments, located three forward and three aft of the engine room. The total heating surface, including superheaters, is 90,000 square feet.

There are two battle dynamo rooms, having turbo-generators, and one smaller electric plant for harbor use, in which the generators are driven by Diesel motors.

The fuel carrying capacity is 4,000 tons of coal and 900 tons of fuel oil, giving a radius of action of 10,500 miles at a speed of 11 knots per hour, 7,200 miles at 15 knots and 3,600 miles at 22.5 knots.

The accommodations for officers and crew are adequate and comfortable, and the lighting, ventilation and sanitary systems are of the latest approved type. In all respects these battleships represent the latest development of battleship construction. The crew will consist of about 1,000 officers and men.

The outfits and equipments of every description are the most complete and elaborate ever supplied to a battleship in this country.

Our Naval Position

As a result of the loss of the French armored cruiser Leon Gambetta, it has been pointed out by a naval officer, the United States navy has undoubtedly regained its place lost to France last year of being the world's third largest naval power. At the outbreak of war France led the United States in naval tonnage by about 5,000 tons, but the loss of the Gambetta, added to that of the battleship Bouvet, probably gives the United States a lead of about 20,000 tons, and restores this country to the position she held early in 1914.

The latest official data giving the known strength of the world's navies appears in the United States Year Book, issued in January last. The following tables, which give the strength of the American and French navies at the outbreak of the European war, are taken from that official record:

FRANCE.

Type.	Number.
Dreadnoughts (built)	4
Dreadnoughts (building)	8
Pre-dreadnoughts	18
Coast defense vessels	1
Armored cruisers	20
Other cruiser types	9
Destroyers (built)	84
Destroyers (building)	3
Submarines (built)	64
Submarines (building)	22

Total tonnage, 899,915.

UNITED STATES.

Dreadnoughts (built)	4
Dreadnoughts (building)	4
Pre-dreadnoughts	22
Coast defense vessels	4
Armored cruisers	11
Other cruiser types	14
Destroyers (built)	51
Destroyers (building)	11
Submarines (built)	30
Submarines (building)	19

Total tonnage, 894,899.

Since the war started France has lost of the ships, included in the navy department compilation, one battleship, one armored cruiser, two destroyers, three torpedo boats, one gunboat, and two submarines. Here is a list of her losses with the tonnage of each lost ship:

Bouvet, (battleship)	12,205
Leon Gambetta (armored cruiser)	12,416
Zeelee (gunboat)	680
Dague (destroyer)	720
Mousquet (destroyer)	298
No. 347 (torpedo boat)	98
No. 348 (torpedo boat)	97
No. 219 (torpedo boat)	100
Curie (submarine)	398
Saphir (submarine)	390
Total	27,412

This tonnage subtracted from the

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total at the beginning of the war would leave the strength of the French navy at 872,503 tons, or 22,396 tons less than that of the United States at the beginning of the war.

Both nations have since the war started began the construction of new vessels, including in both instances a number of superdreadnoughts. Here, however, it is understood in high naval circles the United States probably leads France. The new superdreadnoughts Idaho, Mississippi and California do not figure in the totals of the naval bureau of intelligence, as the construction of no one of them had started when the European war broke out. Since then the construction of the Idaho and Mississippi has begun, and the keel of the California will be laid within the next two months.

Additional Fighting Ships

The addition of these ships adds more than 90,000 tons to the fighting strength of the United States navy. Two other superdreadnoughts have since been authorized by Congress, and contracts for their construction will be let within the next few weeks. When the construction of those two begins it will mean that in superdreadnoughts alone there will be under construction in American navy yards vessels for the United States of a total tonnage in excess of 150,000 tons. Two of the new ships, the Oklahoma and the Nevada, will be ready to take their places in the Atlantic fleet within the present year, the Pennsylvania is more than half completed, and the Arizona will be launched at the navy yard in Brooklyn, May 19.

Large Ore Carriers

How Their Design Has Been Influenced by the Unloading Machines—Modifications of Structure to Facilitate Discharge

By John Reid

AMONG the very varied problems of marine transportation, those relating to the movement of bulk cargoes of coal and iron ore fall naturally into a class by themselves. These cargoes are peculiar by reason of the enormous quantities shipped, the considerable distances which have to be negotiated, and the expeditious methods of handling in loading and discharging which their comparative indestructibility permits. It is, moreover, of paramount importance to the world's industries that the transportation charges on such cargoes should be reduced to a minimum; in other words, that the methods employed in their transportation should possess the maximum of efficiency and economy, not only in their movement by water, but also by railroad, in the loading and unloading of the ships and trucks, and in the storage and rehandling arrangements at the docks and furnaces. In this last respect it is recognized that operators in this country are frequently heavily handicapped by reason of the backwardness of our railroads, the smallness of the vessels employed in this work, the primitive nature of the loading and unloading appliances, and the inadequate storage facilities at all stages of the journey from mines to furnaces. I speak more particularly of iron ore shipped to Great Britain from many foreign countries, in the handling of which we are still far behind the continent, and still further behind the United States in our methods.

In 1899 and following years the author was called upon to investigate American methods of transporting iron ore from the mines to the furnaces with a view to adapting these methods, where suitable, to English practice. It is well known that the principal traffic route for iron ore in the United States is from Duluth and the neighboring ports at the head of Lake Superior to Cleveland, Conneaut, Ashtabula and other Lake Erie ports convenient to the Pittsburgh group of furnaces.

The shipment of ore over this route in one year has reached the enormous total of nearly 50,000,000 tons, the season of open lake navigation lasting only for seven months of the year. It would be natural with such a movement of material in bulk to expect to find remarkable methods of mining and transportation in use; and such is indeed the case. Whether at the mines, on the railroad or on shipboard, whether we consider the size of the locomotives and the train weights moved, the shipping piers, the ships themselves, the unloading appliances, the storage facilities at docks and furnaces, United States' methods of handling iron ore are all on a colossal scale, which has to be seen to be appreciated. It is safe to say that nowhere else is transportation of bulk cargo reduced to such a perfect system or carried on with a like degree of efficiency and economy. It is my purpose to describe briefly the development of the ore steamer of the Great Lakes, and to show how some of its leading features may be adapted with advantage for the ocean-going ore carriers now under consideration as a result of the world-wide range of the ore operators, who seem to be as much concerned to find new sources from which to draw their supplies as are dealers in oil, coal, grain and other staples.

It is particularly important to note the influence in the design of the large ore steamers of the present day which such extraneous matters as the nature of the loading and discharging appliances have undoubtedly had. In 1899, on the occasion of my first visit to the United States, the largest vessels employed in the ore trade were of about 8,000 tons deadweight, of the ordinary single-deck design with the familiar lay-out of the lake type of steamer, viz., engines aft, navigating quarters forward, flush decks clear of erections all fore and aft, numerous short but very broad hatches, spaced 24 feet centers (to suit the loading spouts on the ore piers) and with center pillars of channel section, and numerous through hold beams and deep stringers. It was common in those days on the lakes for the steamer to tow a barge of about the same size and deadweight as itself, a steam towing engine of very ingenious construction being used to prevent sudden snapping strains coming on the tow hawser. The midship section of the vessel of this type is illustrated in Fig. 1.

The well-known Hulett automatic unloader may be said to have revolutionized ore handling methods on the Great Lakes. Owing to the shortness of the open season there, it is, of course, most important to eliminate as far as possible all delay of the steamships at terminal ports. To load a 10,000 or 12,000-ton ore carrier at the Lake Superior ore docks in four or five hours, and discharge it at the Lake Erie terminal in less time, is a common occurrence during the season. This presupposes the storage of the whole cargo of

Read at the spring meetings of the Fifty-sixth session of the Institution of Naval Architects, March 24, 1915.

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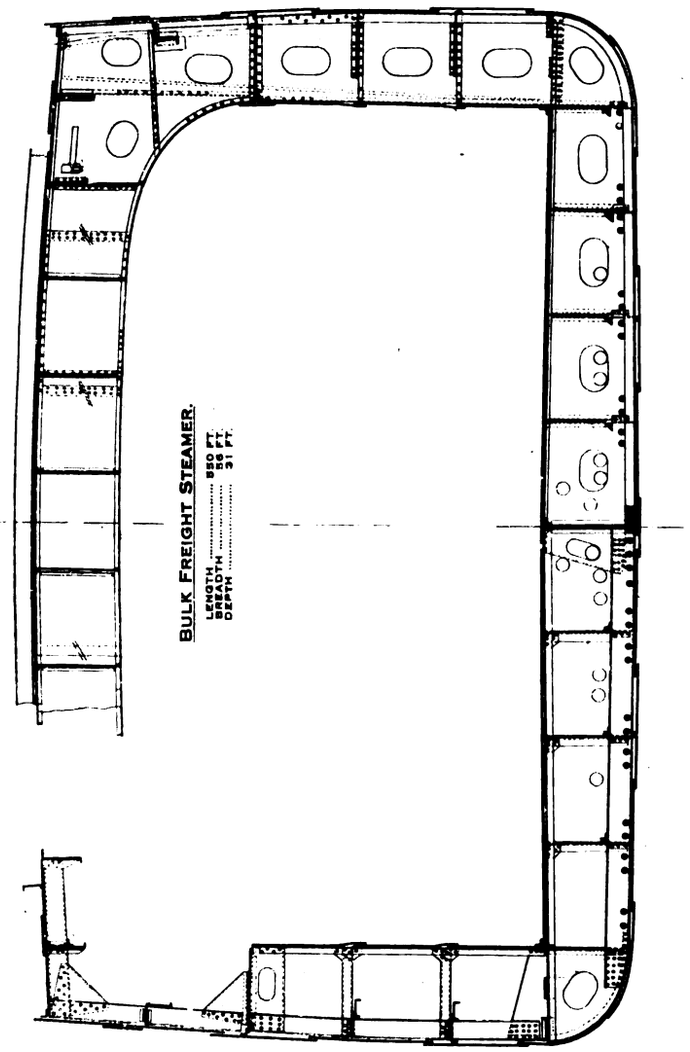
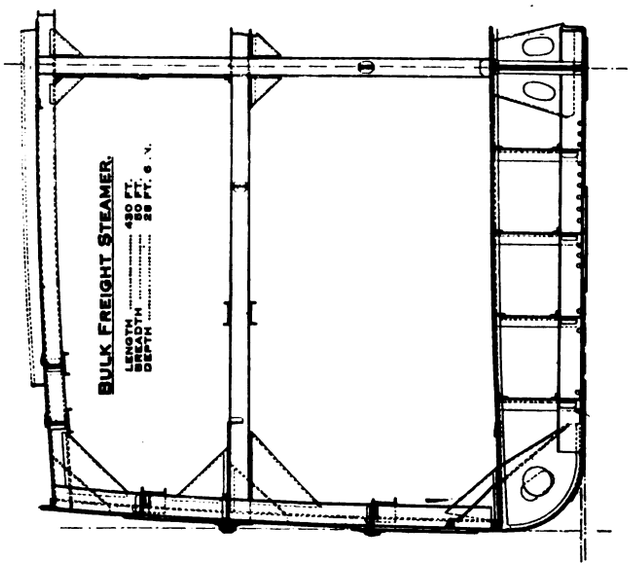


FIG. 2.



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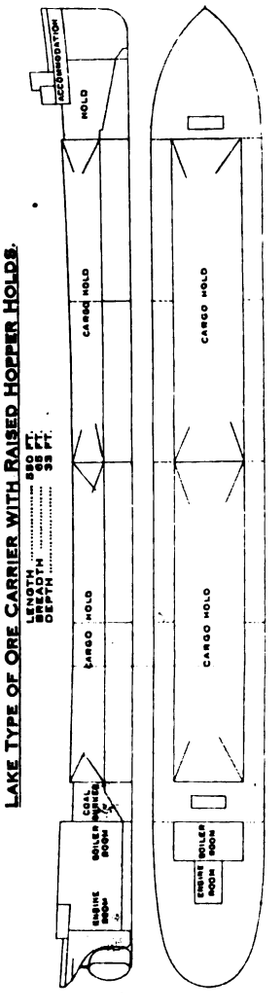

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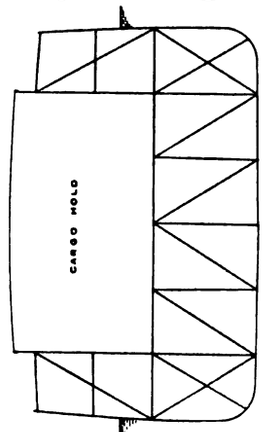

FIG. 4.

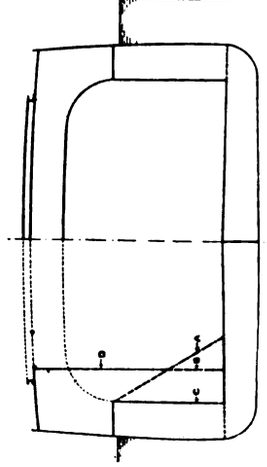

FIG. 3.

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ore in pockets on the loading piers, all ready to be shot into the vessel the moment it is moored alongside. It should be noted that the majority of the Lake Superior ores, being of a consistency similar to dry earth or sand, lend themselves to this method of handling. When the ore is of a coarser nature grinding is resorted to, so that the shipping arrangements may not be interfered with. The unloading of the ore is, of course, a much more serious problem, but it has been brilliantly solved by this Hulett and other machines, now in common use at all the great terminal ports of Lake Erie, and also at the storage piers at the furnaces at Pittsburgh, and other steel centers.

There are, of course, many different types of unloading apparatus adapted to the discharge of ore and coal cargoes, but I have chosen for my purpose the Hulett unloader, because it has been conceived on a truly heroic scale, and because its introduction has had a very noticeable effect on the design of the vessels on which it is engaged. It will be understood that the following description refers only to work on the Great Lakes of North America. There are indications, however, that these machines will shortly be brought into use at tide water ports, but at present the conditions in the ocean-borne ore trade prohibit their introduction.

Hulett Ore Unloader

The Hulett ore unloader was first introduced at Conneaut, Ohio, at the new Carnegie ore docks in 1899. The author happened to be present at the tests of the first machine, which, considering its revolutionary nature and the fact that it was operating on a vessel quite unsuited to up-to-date methods of ore handling, were very successful. The immediate result was a drop in unloading costs of ore from 19 cents a ton, with the best previous appliances, to 6 cents with the Hulett machine. Naturally, with the enormous scope in the lake trade for such appliances, the development of this mechanism was very rapid. Among the latest outfits have been those supplied to the Pennsylvania company and the Canadian Pacific Railway company, which are shown in the illustrations. The following description refers to the former only. The ground plan includes a storage yard of 50 acres, with a concrete dock wall 800 feet long, providing a storage space for 1,000,000 tons of ore. There are four unloaders, each carrying a 17-ton bucket. The unloaders span four railway tracks, and a cantilever rearward extension enables them to discharge the ore 116 feet in from the face of the dock. The maximum outreach when the reciprocating bucket arm is lowered into a vessel is 65 feet from the face of the dock. In order to distribute the ore over the storage area there is a traveling gantry-crane operating behind the unloaders with a main span of 266 feet, and a cantilever at each end of 170 feet.

The method of operations is as follows. The ore in the vessel's hold is first grabbed by the 17-ton bucket, elevated by the rocking arm, run in over a 60 tons receiving hopper on the main frame of the machine, into which it is discharged. From the hopper the ore passes into a 50-ton traveler and scale car, from which finally it passes into railway cars on any or either of the four tracks, or into the temporary storage pile under the cantilever extension, from which the bridge conveyor handles it to the main storage pile. It will be sufficient to give an idea of the scale of the Hulett unloader if I state that the 17-ton bucket shells when open have an extension of 21 feet 3 inches and a telescopic motion of 3 feet. A complete cycle of operations for the bucket takes 50 seconds, which points to a discharge capacity of 1,000 tons per hour or 4,000 tons per hour for the four machines. Of course, this rate is difficult to maintain under all conditions, but 10,000-ton cargoes of ore have been unloaded on the lakes by these appliances and their accessories in less than three hours.

I have already referred to the unsuitable nature of the vessels on which the first trials of the Hulett unloader were conducted. Reference to Fig. 1 will show the disposition of the scantlings of a lake vessel of that period. It will be noted that there are numerous cross beams, pillars, stringers and webs. Tank tops, cross beams, and webs are all liable to severe damage, and the necessity for extra care in using the unloader in vessels of this type reduces the speed of operation and prejudices the efficiency and economy of the unloading appliance.

It becomes imperative, therefore, to consider the improvement of the vessel so as to adjust its interior arrangements to suit this most important development in discharging appliances, and on full consideration I recommended the introduction of a hopper or interior hold formed by carrying two parallel longitudinal vertical bulkheads from the tank top to the upper deck, the wing spaces being utilized for water ballast. It was further proposed to remove all deck plating from between these longitudinal bulkheads, and to tie the ship together by wide spaced heavy arch beams, and to fit portable webs and steel hatch covers for the protection of ship and cargo. It should be remembered that one had under consideration the design of a comparatively deep draught vessel for the English ore trade to be unloaded by very much more primitive apparatus, but the improvements in ore-carrying vessels to be anticipated by a study of the Great Lakes methods seemed to point to important possibilities also in English practice. During visits to the United States in the years immediately following the introduction of the Hulett machine, its effect on the development of the ore vessels was quickly noted, and in 1904 was launched one of the first lake vessels to embody the features above referred to.

It was not found desirable in lake practice to carry the hopper holds to the upper deck. To have done so would have been to cut off so much of the available hold space as to prohibit the use of the vessels for coal and grain, too serious a drawback for the average owner, to offset the advantages for ore cargoes. Therefore, after various experiments in the construction of these hopper holds a fairly definite type was evolved, containing the parallel side walls and arch beams and indicated in the midship section plan in Fig. 2. The diagram, Fig. 3, is drawn to show the process of evolution, the hopper forms marked A, B, C indicating in order the various arrangements of hopper holds adopted. In some recent cases the hopper walls are continued right up to the upper deck, as shown in D.

Distribution of Material

It will be evident that a vessel of this standard lake type, with its double bottom and hopper wing spaces terminating at the level of main deck stringer, has a distribution of scantlings in its midship section which, as regards longitudinal structural girder value somewhat neglects the topsides. Owing to the wide close-spaced hatches, the shallow molded depth, relative to the length, and the lack of longitudinal bracing in way of the fore and aft hatch-limits, the topside strength is still further prejudiced. There are not wanting evidences of a tendency in recent designs to return to a more favorable disposition of the available material. Hatches are now frequently 24 feet centers with 12 feet deck areas between, and efforts are being made, by the adoption of longitudinal framing and longitudinal topside girders above the hopper holds, to return to a more wholesome type, one of the latest and largest of which is shown in Fig. 6. Towards this the adoption of continuous longitudinal vertical bulkheads, forming the hopper holds above described, would materiallly contribute.

A further step in ore carrier design is now impending, which will greatly improve the type and facilitate its discharge.

In cases where large vessels are to

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FIG. 6.

STEAMER "W. GRANT MORDEN."

LENGTH OVER ALL..... 625 FT.
LENGTH BETWEEN PERPS..... 604 FT.
BREADTH MOULDED ..... 64 FT.
DEPTH MOULDED ..... 32 FT.

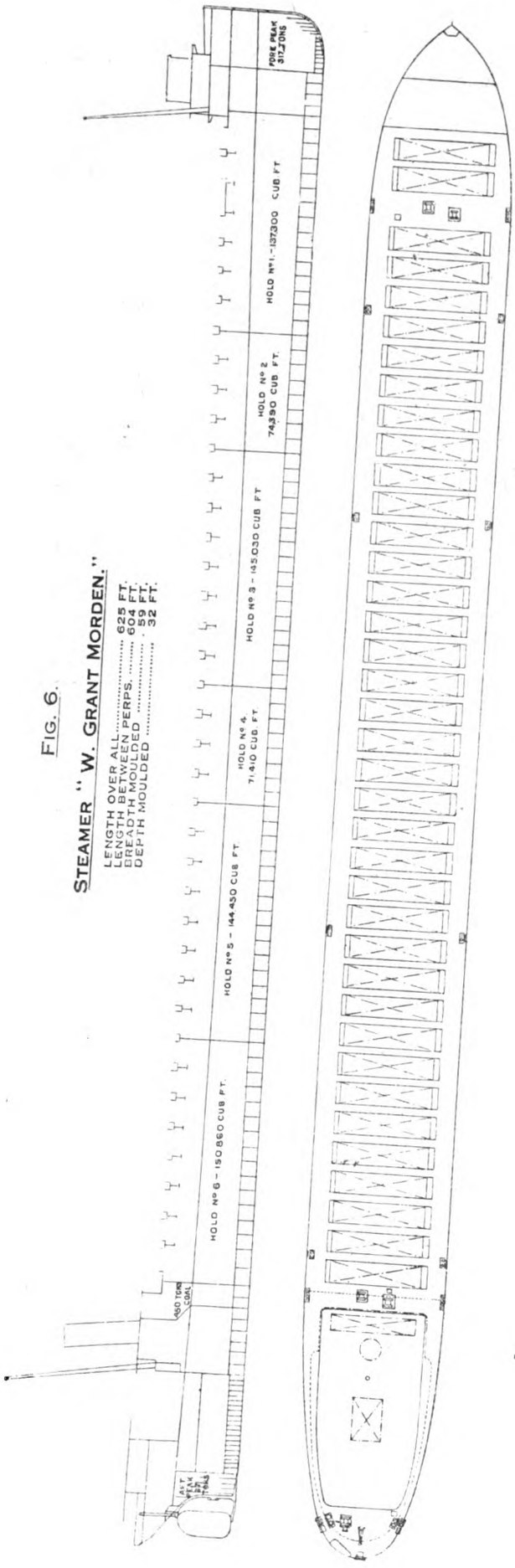
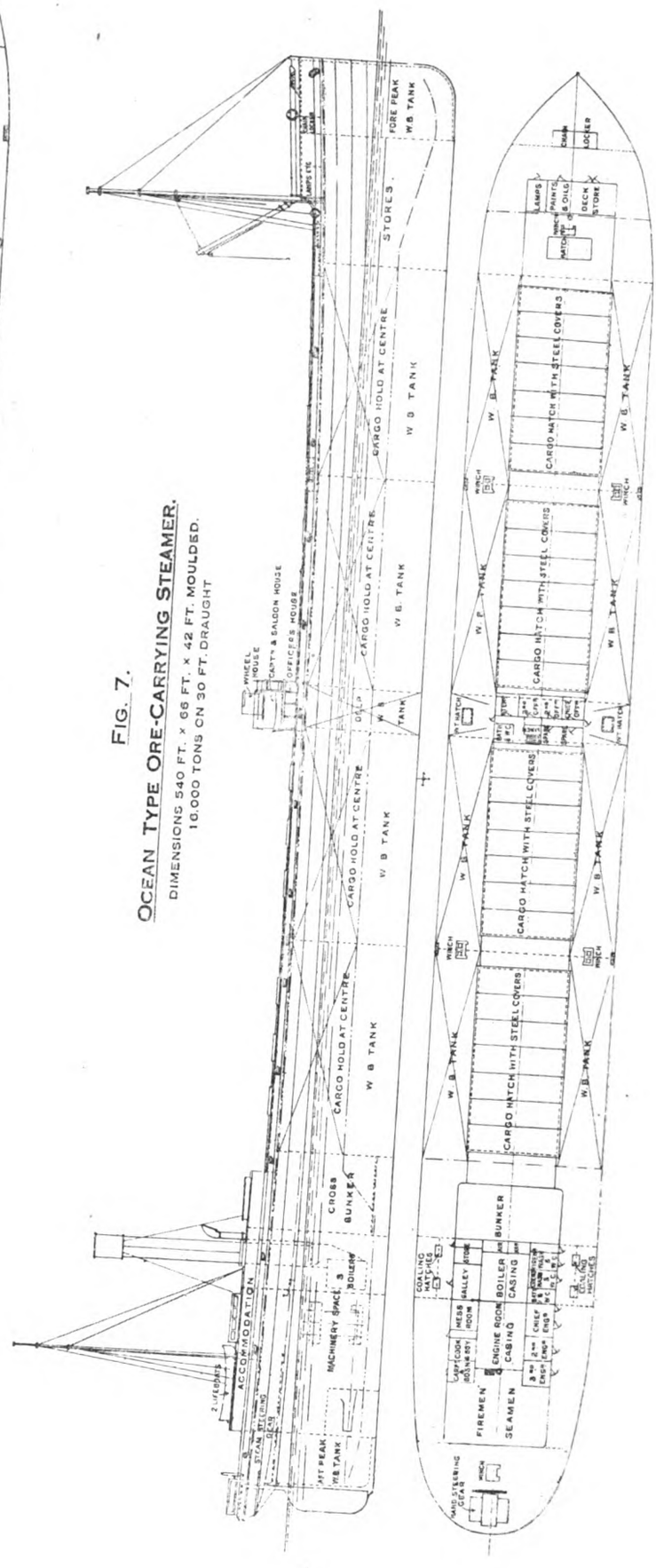

HOLD Nº 6 - 150 860 CUB FT.
HOLD Nº 5 - 144 450 CUB FT.
HOLD Nº 4 - 71 410 CUB. FT.
HOLD Nº 3 - 145 030 CUB FT.
HOLD Nº 2 - 743 90 CUB FT.
HOLD Nº 1 - 137 300 CUB FT.
FORE PEAK BUNKERS
450 TONS COAL

FIG. 7.

OCEAN TYPE ORE-CARRYING STEAMER.

DIMENSIONS 540 FT. × 66 FT. × 42 FT. MOULDED.
16,000 TONS CN 30 FT. DRAUGHT



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be built exclusively for the transport of iron ore, as, for example, in the Narvik-Rotterdam trade, or in the proposed Chilean-United States trade, it may be possible to neglect requirements for other cargoes and to seal off much larger hold spaces than would otherwise be possible. In other words, the ore carrier might be as specialized in its design as the oil tanker, which is generally quite unsuitable for any other cargo. There seems no reason why, in fact, a material such as iron ore should not be dealt with as efficiently and economically as to its transportation as oil and coal, which is certainly very far from being the case at present. With this object in view, the author suggested some ten years ago that a great improvement in seaworthiness and important advantages in general efficiency would be obtained by increasing the depth of the double bottom to, say, 18 or 20 feet, providing a raised platform for the ore, which, in conjunction with the wing bulkheads, would hold the cargo in a concentrated mass as in a box or hopper, so that when the hatches were removed it might easily be tackled by large unloading grabs or buckets. This arrangement is shown diagrammatically in Figs. 4 and 5. This proposal (which, by the way, was one of the first lake designs to have scantlings assigned for Lloyds classification) was submitted to the shipowners of the Great Lakes, but while recognizing the advantages of the arrangement, the loss of hold capacity was so great as to prejudice its general usefulness. It is curious to notice that this design, though discarded for the time being, seems likely nowadays to find large scope in two very different lines of work, viz., in ore carrying in the open sea and in pulpwood carrying in the Canadian lakes and rivers. In the first case I propose the hopper holds and deep tank bottom for the concentration of the ore for easy discharge by grabs, and in the second case for the quick discharge of the pulpwood by flooding the holds. In both cases the absence of large areas of deck plating between the hatch openings is imperative.

It is quite useless to concentrate the ore in a mass in a raised hopper hold if its loading and discharge have to be interfered with by large blind areas of deck material. In that case it would be better to retain the hopper longitudinal walls but to reduce the double bottom depth to normal, so that the unloading buckets or grabs might have ample space under the obstructing deck areas for the necessary swing to reach the concealed positions of the cargo. In Fig. 7, is illustrated a deep-sea ore carrier with raised double bottom and hopper holds and the largest possible areas of hatch openings. To close these openings between the coamings, it may be necessary to consider an entirely new type of hatch cover. Considerable success has already attended the use of hinged covers of steel plate, heavily reinforced with angle or channel stiffeners, but in the present case I should recommend a type of rolling shutter hatch-cover traveling on the hatch coamings and easily controlled by some simple form of winding engine, or even an ordinary ship's winch. The one object to atttain, whichever form of cover is adopted, is that it shall not permit any of the cargo to be screened from the attack of the unloading appliances.

There are, of course, many ways of charging and discharging the holds of large bulk carriers, to some of which reference has already been made in the transactions of this institution. In some cases hopper holds with conveying systems underneath have enabled the vessel to dispense with shore unloading plant; in other cases systems of electric deck cranes have attained very considerable success. As the size of the ore carrier and the length of the average voyage increases, however, it becomes important to keep the ship and the unloading arrangements entirely separate. The time is not distant when we shall have large numbers of ocean-going ore steamers, exceeding in dimensions and deadweight the largest ore carriers of the Great Lakes, which will have to negotiate distances exceeding 15,000 miles each round trip. The cycle of operations involved in the economical handling of an ore cargo under these conditions necessitates the very latest and most up-to-date methods throughout. The hopper hold ore carrier and the automatic unloader are two of the features in this cycle which might well repay careful consideration by those interested in the ore trade in this country.

Car Ferry Scotia II

The car ferry Scotia II intended for service across the Straits of Canso was launched April 14, at Armstrong, Whitworth & Co.'s yard, Walker-on-Tyne, England. As she will have to work in ice her scantlings have been arranged to that end. Her principal dimensions are: Length, over all, 300 feet; length between perpendiculars, 282 feet; breadth extreme over fenders, 50 feet; depth, 20 feet; displacement, 3,570 tons. The form of the ends has been arranged to comply with the exacting conditions of service so far as is compatible with the full deck line required by the fact that there are three railway tracks to be accommodated on the deck, with room for 21 freight cars and 9 heavy passenger cars, which makes the problem one of considerable interest.

The propelling machinery consists of two sets of triple-expansion engines, having cylinders 21, 34 and 54 inches by 30 inch stroke, developing a total of about 3,000 indicated horsepower and rated for 10.5 knots, each actuating a propeller, one at the forward and the other at the after-end of the vessel. The engines are so arranged that both propellers can be worked together or separately, and either can be arranged to work both propellers. One engine has a shaft extending from the after end of the vessel—its usual position—to the forward end of the vessel, so that the vessel has two propellers, one aft and one forward, driven off the same line of shaft. The machinery throughout is of a strength sufficient to resist the shocks encountered while working among ice, even though they are sufficiently severe to stop propellers when working at full speed. Accommodation is provided for two captains and two sets of officers, one for night and the other for day service.

The control for the navigation of the vessel is arranged in a pilot house on a specially high bridge, in which are fitted the usual steering gear and telegraphs, and a projector is arranged immediately overhead for working at night. The comfort of officers and crew is provided for so far as is possible in a vessel of these dimensions under the varying temperatures, and care has been exercised in all details to avoid any interference with the working of the vessel under extreme winter conditions.

The steamer J. Frater Taylor, of the Algoma Central Steamship Line, ran aground on Blake Point, Isle Royale, April 20, breaking her stem and damaging fourteen plates. She was taken off by the Whalen wrecking company and her cargo was transferred at the Paterson elevator to the steamer Martian in 72 hours. The loss of grain amounted to only 700 bushels. The captain claims that if the gas buoy had not been lighted he would not have met with disaster. The buoy was lighted at Blake Point and he took it for the lighthouse on Passage island. The Blake Point gas buoy flashes every ten seconds, the same as the lighthouse on Passage island. All the lighthouses were lighted, but none of the buoys, which obviously made it all the more misleading.

The naval oil tanker Maumee was launched from the Mare Island navy yard on April 14. The Maumee is 475 feet over all, 56 feet beam and 26 feet 4 inches deep.

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Isherwood System of Construction*

Showing the Arrangement of Plating on the Tank Top and Expanded Plates on the Side

By Robert Curr

THE PLAN herewith shows the arrangement of plating on the tank top and expanded plates on the side.

The water ballast compartments extend from No. 2 to No. 29, a length of 177 feet.

No. 12 and No. 24 are watertight divisions, making two compartments on each side before No. 24 and one under engines.

On the midship section it will be seen that the water bottom extends up the sides for 5 feet above the tank top, the top of same following the sheer from bulkheads No. 2 to No. 20.

The object of this side arrangement is that it prevents leakage in the hold. The denting of the bilges and shearing of rivets in canaling very often happens immediately above the tank top and where the usual bilge ceiling is fitted does not prevent the water getting in the hold and damaging the cargo.

In this arrangement the leakage is in the tank and easily taken care of by the pumps.

The margin between No. 2 and No. 20 is of 12-inch channel, and forms a girder between these bulkheads, adding considerable strength to the vessel.

The center keelson under the rider plate is of the usual arrangement, composed of double angles on the top, extending in one continuous girder from No. 2 to No. 29 and is made watertight between No. 2 and No. 24.

The longitudinals, a, b, c, d, e, f, g, h, and j are spaced the same as the shell longitudinals, as shown on the plan; f longitudinal is under the bottom angle of the plating slanted up the side, g longitudinal begins at No. 20 and runs along to beyond No. 24.

The longitudinals h and j are divided equally between the tank top and the margin on slanted plating and are continuous between No. 2 and No. 20.

The transverses are spaced 6 feet 2 inches between No. 2 and No. 24, and in the engine space, half the distance.

The advantage obtained in this arrangement is easy access to the water bottom, increased longitudinal strength, and less material to handle during bottom repairs, caused by grounding.

*This is the twenty-third of a series of artices on the Isherwood system of construction which began in the September, 1912, issue of *The Marine Review*. The first article dealt with the general specifications of the steamer; the second with the sheer, half-breadth and body plans; third explained the method of getting the sheer; the fourth dealt with the longitudinal and transverse framing; the fifth with offsets; the sixth with the shell plating; the seventh with the shell plating expansion; the eighth with the arrangement of plates and angles forming the spar deck; the ninth with the transverses; the tenth with bulkhead construction; the eleventh with the connection of longitudinal frames to the bulkheads and transverses; the twelfth showed the interior framing between the tank top and spar deck; the thirteenth showed the amount of work that can be put together in a Great Lakes ship yard in a few hours; the fourteenth showed details of riveting in shifts of butts; and fifteenth considered the subject of butt straps and laps; the sixteenth discussed Lloyds rules and their application; the seventeenth showed certain details of the transverse and longitudinal system; the eighteenth gave calculation for the neutral axis and moment of inertia for the transverse framed vessel; the nineteenth showed the materials in the section of the Isherwood vessel; the twentieth showed the arrangement of framing in the engine space extending from frames 24 to 30; the twenty-first showed the bow plating and framing; the twenty-second showed the stern construction abaft No. 30 bulkhead.

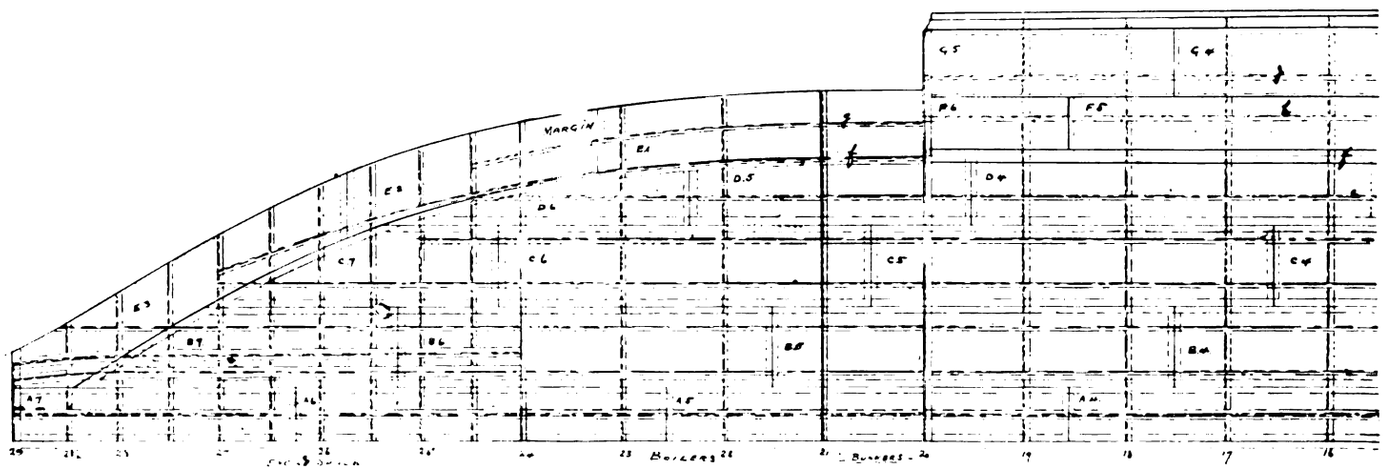
Measurement of Shelter Decks

Eugene Tyler Chamberlain, commissioner of navigation, has sent the following letter to collectors of customs in regard to the measurement of shelter decks and closed in spaces:

Inclosed is a copy of Bureau circular of March 16, 1915, concerning the measurement of "shelter decks" and "closed-in spaces."

In the application of paragraph 14, shelter for deck passengers, you are advised that cabins and staterooms immediately on the upper deck to the hull, permanently "closed-in" and fitted up for permanent use of passengers, are to be included in the gross tonnage. They will be exempted only when they have no berthing accommodations and, in your judgment, are open as defined in the circular, having only temporary arrangements to protect passengers on short voyages from rain and the shipment of seas, as, under the law, nothing shall be added to the gross tonnage for any sheltered space above the upper deck which is under cover and open to the weather; that is, not inclosed.

When in doubt as to whether passenger spaces immediately on the upper deck to the hull are open or not, application should be made to the Bureau for directions, accompany-



THE TANK TOP

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ing such application with your report as to the nature of the erections and the openings therein, as provided for in paragraph 14 of the said circular.

The circular follows:

I. *Definitions of tonnage.*—The gross tonnage of a vessel shall consist of the sum of the following items:

(*a*) The cubical capacity below the tonnage deck;

(*b*) The cubical capacity of each space between decks above the tonnage deck;

(*c*) The cubical capacity of the permanent closed-in spaces on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew;

(*d*) The "excess of hatchways"; and

(*e*) All permanent closed-in spaces wherever situated used for cargo or stores, or for the accommodation of the crew, or for the charts and navigating instruments, or for wireless apparatus or berthing and accommodation of the operator.

The net tonnage shall be the above, less the spaces hereinafter directed to be deducted.

II. *Special rules and definitions.*—If the second deck from the keel consists of several partial decks extending with breaks from stem to stern, the line of that course of decks must be taken as the tonnage deck; and if the partial decks are at different heights, the line of the lowest will be taken as the tonnage deck, and the headroom above such line under the higher will be measured.

III. *Measurement of spaces on the upper deck.*—1. Revised Statutes, 4153, as amended March 2, 1895, provides that if there be a break, poop, or any other permanent closed-in space on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crew, it must be measured and included in the gross tonnage.

2. In carrying out this direction and deciding whether or not deck erections should be measured and added to the tonnage, the measurer should have regard to the character and structural condition of such erections at the time when they are presented to his notice.

Poops, bridges, or any other permanent erections with one or more openings in the sides or ends not fitted with doors or other permanently attached means of closing, but otherwise so closed in as to be not only available but also actually fitted and used for the berthing or accommodation of passengers, must be measured and added to the tonnage.

3. Subject to the foregoing exception, poops, bridges, or any other permanent erections with one or more openings in the sides or ends not fitted with doors or other permanently attached means of closing them should not be measured and included in the tonnage.

4. The minimum width and height of the permanent openings in the bulkheads is fixed at 3 feet and 4 feet, respectively, and if coamings are fitted thereto, their height must not exceed 2 feet.

5. A single opening at one side of a bulkhead is not considered sufficient to entitle the space thus partitioned off to exemption, unless in addition to this there are a number of freeing ports and scuppers fitted on each side of the space claimed. In such cases the owner's application for exemption, and also a sketch of the space drawn to scale, must be forwarded to the commissioner of navigation for examination, and exemption must not be allowed without the Bureau's approval.

6. *Shelter-deck spaces.*—When exemption from measurement is claimed for the space between the upper and shelter decks on the ground of a permanent middle line opening in the shelter deck, the length of this opening must not be less than 4 feet clear, and the width must at least be equal to that of the after cargo hatch upon the same deck. The distance between the after edge of the deck opening and the aft side of the sternpost must not be less than one-twentieth the registered length of the vessel; or if the opening is placed forward, the fore side must not be less than one-fifth the length of the vessel from the stem. When the permanent deck opening is situated aft there must be at least two openings in all the transverse bulkheads in the 'tween decks on the fore side of it to entitle the space to exemption, and these openings must comply as regards dimensions and size of coamings (if any) with the requirements of paragraphs 4 and 5 above.

7. There must also be on each side at least one freeing port of good size abreast the deck opening and a suitable number of scuppers not less than 3½ inches in diameter distributed throughout the space.

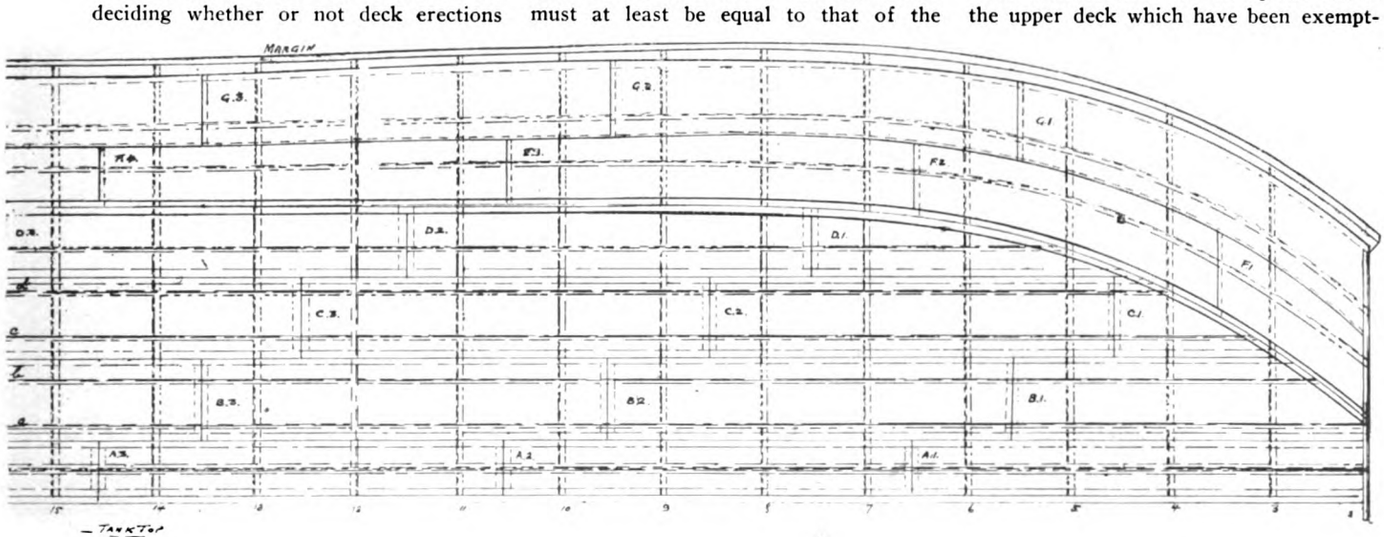
8. The coamings to the deck opening must not exceed 12 inches mean height above the deck, and the opening must be fenced with guardrails and stanchions, the latter being so fitted as not to lend themselves to battening down the opening.

9. If portable wood covers are fitted, the lashings beneath for holding them down are to be of hemp.

10. All openings in the upper deck must be provided with proper means for closing and battening down.

11. The tonnage measurement of all spaces above the upper deck that the measurer has *not* included in the gross tonnage of the vessel should be given in detail on the tonnage admeasurement form, which, when forwarded to the Bureau for test and examination, should be accompanied by any plans, sketches (drawn to scale), or explanation required for the proper consideration of the exempton of such places.

12. Should there be no spaces above the upper deck which have been exempt-



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ed, this should be noted on the tonnage admeasurement form.

13. The measurer should be careful to record in the space provided on the above form the principal dimensions, tonnage, and position of all spaces above the upper deck that are not included in the cubical contents forming the ship's registered tonnage.

14. *Shelter for deck passengers.*—The act provides that no addition shall be made to the tonnage in respect of any building erected on the upper deck for the shelter of deck passengers and approved by the Bureau. When application is made, or when the collectors think there is a claim for the exemption of any such space fitted for the shelter-deck passengers on short voyages, who would otherwise be exposed to spray and shipment of seas and other inclemencies of the weather the collectors should apply to the Bureau for directions, describing the erection and how it is secured, with any particulars they think necessary. A scale drawing showing the space or spaces and indicating the water-closet arrangements for the men and women, respectively, should always accompany the application.

Closed-in spaces which may be exempted.—The following exceptions to the general rule of measuring all closed-in or weather-protected spaces on or above the upper deck are allowed:

(*a*) Any closed-in space or spaces solely appropriated to and fitted with machinery.

(*b*) The wheelhouse for sheltering the man or men at the wheel.

(*c*) The cookhouse and also the bakeries when fitted with ovens and used entirely for such purposes.

(*d*) The condenser space.

(*e*) Water-closets or privies for the officers and crew; and in the case of vessels fitted particularly for passengers, an additional one may be allowed for every 50 persons; not more than 12 are, however, generally necessary.

Provided always that the spaces are no longer than required for the purposes mentioned.

In motor boats, having the engine in a house used for other purposes, exempt so much of the space above deck as equals the product of length of the engine, plus 2 feet, by one-half breadth of the boat at that part, by the height of said house.

Spaces havng angular recesses in their sides, as the freight room in Fig. 2, plate 4, Customs Regulations, 1908, are to be measured in parts (R. S., 4150, 4153).

As instructed in general letter No. 80, Bureau of Navigation, dated September 5, 1914, you may receive and forward with your report under article 84 an application by the owner of any seagoing steam vessel of the United States for a review of the measurement on the ground that additions in the outstanding registers have been made to the gross tonnage for sheltered spaces above the upper deck (act of March 2, 1895, section 1 (h), which is under cover and open to the weather; that is, not inclosed.

Owners should be advised that where a vessel is treated as a shelter-deck vessel, the freeboard, ascertained under foreign load-line laws and regulations and by the classification societies, will doubtless be measured downward from the line of the deck below the shelter deck.

Motor Tank Ship Emanuel Nobel

The motor tank ship Emanuel Nobel has just completed a passage from Rouen, France, to Marcus Hook in 14 days. The Emanuel Nobel is 390½ feet long, 51 feet beam, 29 feet molded depth and 23 feet draught. She has a cargo carrying capacity of 2,000,000 gallons. Her deadweight capacity is 6,500 tons which includes 350 tons fuel, 30 tons stores, 100 tons fresh water and 40 tons drinking water. She is a twin-screw vessel, having two six-cylinder sets of Werkspoor direct reversible, single-acting four-cycle Diesel engines, 22-foot bore, 39⅜-inch stroke and 125 revolutions per minute. The indicated horse power is 1,360 per engine, the brake horse power 1,020. In actual service the combined power developed is about 2,650 indicated horse power at 105 revolutions per minute. Each engine is 27 feet 3 inches long, 8 feet 6½ inches wide and 16 feet 9½ inches high above shaft. The weight per engine is 122 tons. The lubrication is sight feed drip and the lubricating oil consumption is from 35 to 40 gallons per day. The fuel consumption, including auxiliaries, is not over nine tons per 24-hour day in summer or about 0.31 pounds per indicated horse power hour. This economy is effected by utilizing the waste exhaust gases of the main engines to fire the two donkey boilers. When the main engines are not running, oil-fired burners are used. The engine room staff consists of 12 men all told.

The Emanuel Nobel was built by the Netherlands Ship Building Co., Amsterdam, and the engines were supplied by the Werkspoor Co. of Amsterdam. The representative of the Werkspoor Co. in this country is T. Orchard Lysle, 254 West Thirty-fourth street, New York.

Capt. William S. Benson, commandant of the Philadelphia navy yard, has been appointed to the newly created post of chief of operations of the navy.

Merchant Ship Building in Great Britain

It is of particular interest to note how the volume of new shipping launched compares with the extent of the destruction of merchant vessels due to the operation of the submarine "blockade" by Germany. In the first three months of the year the number of British merchant vessels sunk by enemy cruisers, by mines or by submarines, totaled 48, including British fishing vessels sunk or captured, and the tonnage 130,358 tons. The tonnage of vessels launched from British yards, excluding vessels under 100 tons, was more than double this—267,612 tons, the measurement of 125 vessels, and that, too, notwithstanding that the conditions were in every sense opposed to extensive work on merchantmen. The urgency of the work for the navy has made it impossible for shipbuilders in many cases to devote any attention whatever to mercantile work, although shipowners are specially anxious not only to secure delivery of the vessels already under construction, but to place orders for further tonnage, in view of the large amount of shipping withdrawn from the over-sea carrying trade for war service, and the resultant high freight rates obtainable. Prices quoted for new tonnage have had to be greatly increased, not only because of the large advance in the cost of material, but also increases in wages. Notwithstanding this, however, the firms able to undertake naval work are willingly foregoing the advantageous terms which shipowners are ready to give, devoting their plant and available men to meeting the requirements of the war office and the Admiralty.

It is because of these well-known facts that the number of vessels launched during the past three months is only 125, making up an aggregate of 267,612 tons; in normal times the tonnage launched is about 400,000 tons per quarter. Notwithstanding this decreased output, the work in hand shows a decrease of 40,000 tons as compared with the beginning of the year, whereas the decrease on the total of 12 months ago is 303,000 tons. Only one district shows an increase as compared with a year ago—namely, the Tees, where the addition is equal to 4.3 per cent. When comparison is made with the beginning of the year, it is found that such notable merchant shipbuilding districts as Greenock, the Tees and the Tyne have added to the amount of work in hand, the percentage of increase at the Tees being 20.3 per cent; at Greenock, 12.3 per cent, and on the Tyne, 11.8 per cent. The

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demand for trawlers, owing to the extensive use of the existing fleet for war service, has resulted in an increase of work on hand at Hull now, as compared with January, of 17 per cent.

The total number of merchant ships of over 100 tons building in the United Kingdom is 471, representing a tonnage of 1,587,467 tons, whereas a year ago the number of ships building was 535 and the tonnage 1,890,856 tons. Of the important districts, Glasgow appears to be devoting much more attention to war work, as only 86 merchant vessels, of 371,550 tons, are being built. This tonnage is 22.4 per cent less than a year ago and 6.8 per cent less than three months ago. At Greenock, as we have already said, there is an actual increase as compared with three months ago, but a decrease of 8.5 per cent on the figures of a year ago, the number being 49 and the tonnage 217,938 tons. On the Tyne, where 72 vessels, of 300,997 tons, are on the slips, the decrease, as compared with a year ago, is 5.7 per cent. At Sunderland, where 42 vessels, of 161,342 tons, are in course of construction, there is a decrease of 13.7 per cent, when comparison is made with the total tonnage of December, and of 20.9 per cent on the total of a year ago. On the Tees, with 40 vessels, of 86,915 tons, in progress, the position is more favorable than three months or a year ago. At Hartlepool and Whitby, 13 vessels, of 61,830 tons, are building, and here the decrease, as compared with a year ago, is 26.6 per cent, and as compared with three months ago, 13.7 per cent. The tonnage of the 11 vessels being built at Liverpool—28,330 tons—is only equal to half the tonnage in progress a year ago, and is 13.2 per cent less than the total three months ago. In the Humber there are 58 vessels, of 29,794 tons, under way. This is 10.6 per cent less than a year ago, but 17 per cent more than three months ago. Belfast shows a decrease, the 27 vessels, of 280,180 tons, being 14.8 per cent less tonnage than in January, and 16.3 per cent less than in April last year. These deductions are made from the latest return by Lloyds Registry.—*Engineering*, London.

Cargo Carrier Wentworth

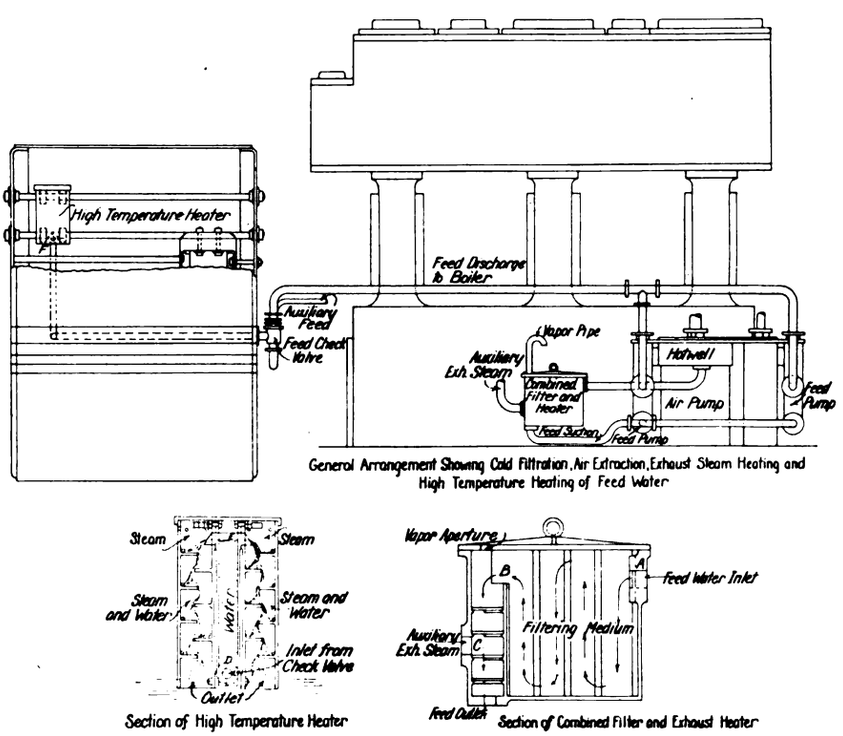
An Excellent Type of a Modern Cargo Carrier —Douglas System of Feed Water Filtering

AN excellent example of a modern cargo carrier is represented in the steamship Wentworth, recently delivered by Messrs. John Priestman & Co., Ltd., of the Castletown Shipbuilding Yard, Sunderland, England, to the order of R. S. Dalgliesh, the managing owner of the Dalgliesh Steam Shipping Co., Ltd., of Newcastle-on-Tyne, England. She takes the highest class of Lloyds Registry, and has the following dimensions:

Length between perpendiculars.	350 ft. 0 in.
Extreme breadth	50 ft. 10 in.
Depth, molded to upper deck..	26 ft. 0 in.
Depth, molded to shelter deck..	34 ft. 0 in.
Draught	23 ft. 8 in.
D. w. capacity, tons.....	7,300

As will be gathered by a reference to the midship section the hull is constructed on the single deck principles with deep frames of heavy bulb angles, and the holds having been kept singularly free from obstructions are large and clear for the convenient stowage of bulky cargoes. A cellular double bottom extends fore and aft, arranged on the latest system of construction with a deep plate floor and bulb angle floor on alternate frames, except under the engines and forward of the three-fifths length, where the deep plate floors are on every frame. There are six steel watertight bulkheads, all supported by bulb angle stiffeners, the after peak bulkhead being specially strengthened for water ballast. A complete shelter deck extends all fore and aft, and this gives the vessel a large measurement cargo capacity, the lofty 'tween decks being also suitable for carrying cattle.

The propelling machinery, constructed at the Sunderland works of the North Eastern Marine Engineering Co., Ltd., consists of a set of triple expansion surface condensing engines supplied with steam from three large natural draft boilers working with a steam pressure of 180 pounds per square inch. The engines are of the most modern type for this class of vessel, having cylinders 25 inches, 41 inches and 67 inches in diameter, with a stroke of 45 inches. The high pressure cylinder is fitted with a hard cast-iron liner and all of the pistons and slide rod glands are provided with metallic packing. The cylinders are supported by six columns, three of cast-iron at the back and three of forged steel at the front. The high pressure slide valve is of the piston type having a separate renewable chamber, while the intermediate pressure and compressure valves are of the double ported D type. Reversing is effected by means of a single cylinder steam



DOUGLAS SYSTEM OF HIGH TEMPERATURE FEED WATER HEATING AND FILTRATION

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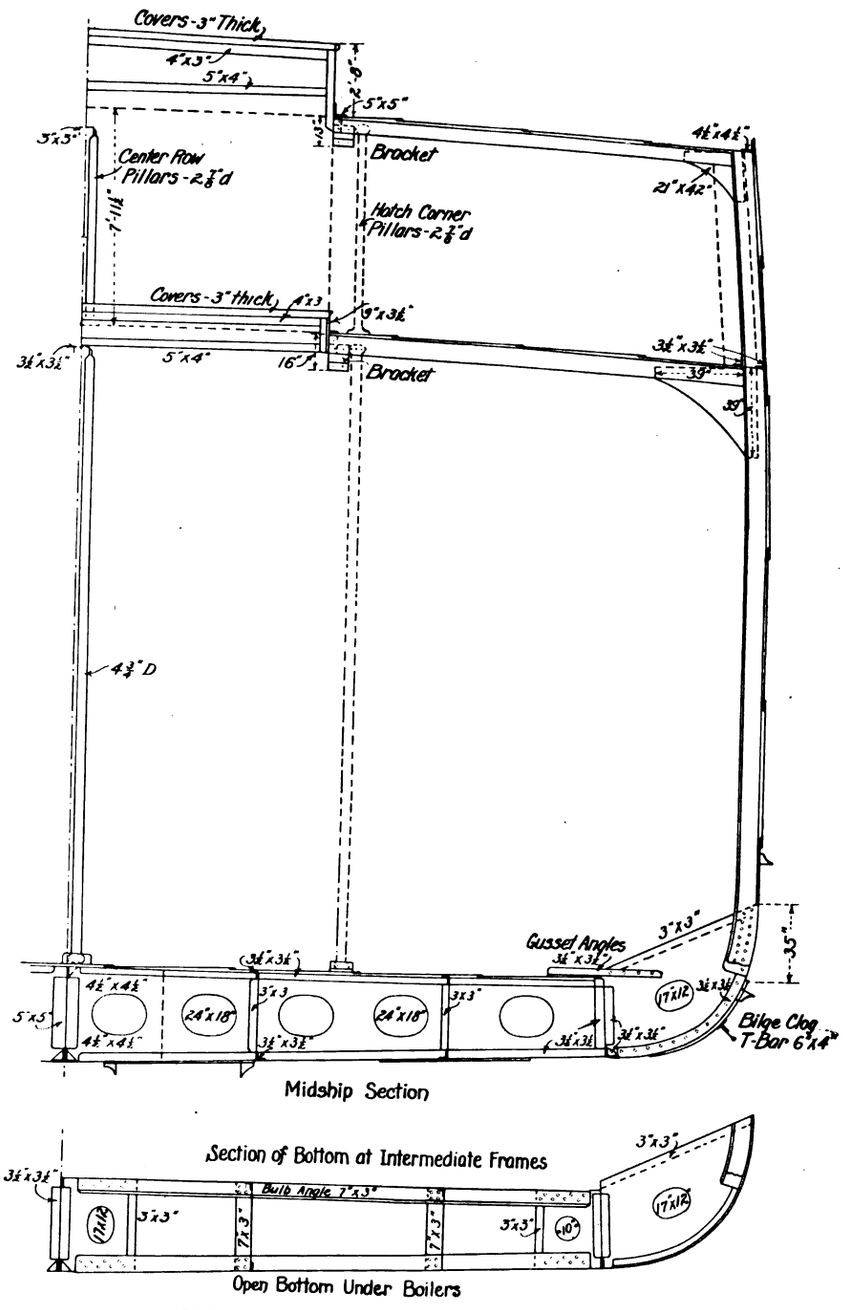
engine, with worm gear and large handwheel arranged at the starting platform. Each reversing lever is provided with a slot head so that the cut-off in each cylinder may be independently adjusted. A single cylinder engine operating through double reduction worm gearing is provided for turning the main engines. An Aspinall's governor of the latest pattern is connected to the butterfly throttle valve between the engine stop valve and the horsepower casing. The air, circulating, feed and bilge pumps are driven by means of levers from the compressure engine. The air pump is of the Edwards type, the circulating pump is of the double acting plunger type, while the feed and bilge pumps are of the ram type and in duplicate. The condenser is supported from the back columns and it is cylindrical in form, the shell being built of steel plates and the ends of cast iron. Ample cooling surface is provided, and the condenser, air and circulating pumps are so designed as to obtain high-vacuum when the vessel is trading in tropical waters.

There is a comprehensive auxiliary machinery installation. A general service pump for boiler feeding, deck and sanitary purposes is supplied, and there is a special independent feed pump for use in port in the event of any of the three main boilers being used as a donkey boiler. There is a large evaporator and winch condenser, the latter having been supplied by Messrs. Willcox, Bros., of Sunderland, and is capable of condensing the exhaust steam from all the winches and auxiliary machinery. In addition there is a fresh water distiller by Messrs. Hocking & Co., Liverpool. The boilers are of the cylindrical multitubular type, 13 feet 6 inches diameter and 10 feet 6 inches long, each with two furnaces, 4 feet diameter, and of the Deighton corrugated section. The furnaces are withdrawable, and each has a separate combustion chamber built to the latest "North Eastern" design. Each combustion chamber wrapper or side plate is rolled in one length, with the bottom part specially thickened, thus avoiding the trouble sometimes experienced with the three-ply joint and dispensing with a separate bottom plate.

An interesting feature is the adoption of the Douglas system of feed water filtering and heating, which consists of a combined gravitation filter and direct contact heater. The feed water flows from the hotwell and enters the filter at *A*, Fig. 2. It goes down and up through the filtering medium, which is coke or clinker, and through the holes or over the lip at *B*, and down through the heater meeting the exhaust steam from the auxiliaries at *C*, with which it mixes, and on to the feed pumps. In order to keep the supply coming down in a more or less constant stream the feet is dammed at *D*. After the feed leaves the pumps it passes on through the check valves and into the bottom of the high temperature feed heater at *D*. It then rises up and flows over at *E*, and down over the zigzag plates mixing with the steam until it is of the same temperature and then it is discharged at *F* among the water in the boiler. The advantages claimed for this combined feed water filtering and heating arrangements are: (1) the water is filtered at its lowest temperature: (2) the filtering medium is easily renewed by disconnecting at *A* and lifting out the inner case: (3) no water can pass without being filtered; (4) the cover can be taken off and the working of the machine examined while the engines are running; (5) exhaust steam is used with consequential economy: (6) repairs unnecessary, as there is no apparatus to get out of order and no zinc plates are required in the boilers; and (7) the small initial cost compared with machines doing much less effective duty.

The Wentworth has an excellent deck equipment for handling cargo.



MIDSHIP SECTION OF STEAMER WENTWORTH

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There are four large main hatchways on the upper and shelter decks, and also auxiliary hatchways amidships, and at the after end. The wood hatch covers lie fore and aft and they are supported by transverse plate webs only. The masts are strengthened and fitted with outriggers to carry the double derricks at each hatch. Nine powerful steam winches of Messrs. Clarks, Chapman & Co.'s latest type are installed for dealing with the loading and discharging of cargo. The vessel is fitted up with wood shifting boards, feeders, etc. all to the requirements of the Board of Trade for the transport of bulk grain. The steam steering gear is by Messrs. Donkin & Co., Ltd., and the motor boat—somewhat of an innovation in the outfit of a tramp steamer— was built by Mr. Spain, of Sunderland, and it is fitted with a 7 barge horsepower engine supplied by the Page company, of Baltimore, Md. The accomodation for the officers and crew is upon a generous scale, each officer having a large single berth and the crew has spacious quarters forward and arranged under the most sanitary conditions. The whole of the accommodation is furnished with electric light supplied by Messrs. Clarke, Chapman & Co., Ltd. On the loaded trial trip the machinery fulfilled all the specified conditions to the satisfaction of the owners and their marine and engineering superintendent, D. B. Cumming, of Newcastle-on-Tyne, under whose supervision the hull and machinery were constructed.

Types of Cargo Carriers

An Analysis of the Line of Expected Development in the Near Future—Advantages of Various Systems

By Thomas Osborne

STRUCTURAL development and improvement in cargo vessel design resulting from the very varied requirements of international commerce are at present a notable feature of the ship building industry. Cargoes vary within the widest limits consequently a very great range of types are called for; thus steamers suitable for the fruit trade, differ essentially from those carrying oil or wheat in bulk. Cargo vessels have hitherto been very generally constructed without longitudinal bracing, resulting in a latent weakness, which under normal conditions may not interfere with the successful working of the vessel; but which in case of emergency or exceptional stress may result in disaster. To mention an instance, the disaster to the Oklahoma, which was a vessel actually constructed with side stringers, but which under exceptional conditions was found wanting in strength to resist strains to which it was unexpectedly subjected. A stringerless vessel was from several points of view very convenient, in as much as there were no shelves for the lodgment of grain, coal or other bulk cargo, moreover the cost of construction was less. The result of experience has shown that the plating is more vulnerable to damage between the frames, and the whole vessel is exposed to greater injury from broaching on collision. For small cargo vessels the corrugated sided type of construction has been found successful; it is one likely to be extensively adapted, as many advantages are claimed for it and it has successfully passed through a limited time test. It is stated by experts that the corrugations have the effect of improving the steering qualities of vessels, that the rolling and pitching in a seaway are appreciably reduced and that the speed is increased. There is moreover a gain in the deadweight capacity of an amount equal to the corrugations. Up to the present this method of construction has not been adopted in cargo vessels of large size or of high speed, so that it is not yet possible to state whether proportionate economies will be maintained irrespective of dimensions.

Another interesting variety introducing novel principles and ideas is the Ayre-Ballard, or arch principle of construction, consisting of a transverse arch over and above the normal hull and forming an integral part of the same. This form of construction enables pillars to be dispensed with, an advantage, as it enables a comparatively clear hold to be obtained. This type would appear to be mainly suitable for single deck vessels, so far steamers of large size have not been constructed in accordance with the arch principle. There are opportunities open both for the engineer and the capitalist; the last word in ship construction may not be heard for generations. Who a generation back could have foreseen a vessel without funnels driven by power?

The principle of longitudinal framing has many convinced advocates urging its advantages and advising its adoption. A comparison between two vessels, one constructed with longitudinal frames and one without illustrates the strong points of the former. In the case of two vessels of identical dimensions, one with longitudinal framing and one without (the dimensions being, length 399 feet, breadth 51 feet molded, by 28 feet 3½ inches molded, a deadweight carrying capacity of 8,000 tons and draught of 24 feet) then the one with the framing has an increased deadweight capacity of 200 tons, equal to 2½ per cent of the deadweight capacity of the ordinary vessel, together with a longitudinal strength of 15 per cent in excess of that built on the ordinary transverse system; both vessels being single-decked. Other advantages are claimed, which would require a special article to describe in detail. An important point of difference is that the floor of the vessel is carried out flat to the side of the vessel instead of peaking the bilge brackets as is customary in vessels of ordinary construction. It is claimed that the flat floor gives an increase in cubic capacity and that the absence of beam knees results in an increase in the capacity for storing bale goods. Experienced ship designers state that in vessels engaged exclusively in the lumber trade, the loss in capacity can be neutralized by building vessels broader or longer than usual. To quote an actual experience, in one case where an order was given for a lumber ship of 16,500 tons deadweight, with the same internal capacity for long timber as the transversely built ship, it was found that an increase on the original dimensions of 15 feet in length gave an increase in deadweight of 900 tons, with the use of 200 tons less steel than would be required in an ordinary vessel of smaller dimensions. Some experts have raised an objection to the longitudinal frame principle, that the longitudinal formed shelves on which coal, grain or other bulk cargo could lodge, but that may be answered by the fact that these frames in a vessel of 8,000 tons deadweight would only accommodate four tons in that way, which could be readily swept off, as the longitudinals themselves formed ladders up the sides of the ship. Moreover this system has been found to be better suited for ventilation and it rendered the hull practically free from vibration. It also facilitates expeditious cleaning and opens up the possibility of successfully increasing the length of a given vessel while still

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retaining the same breadth and width. The principle has been very extensively used, thus during the period of the oil ship boom no fewer than 90 vessels of this type, with an aggregate of no less than 528,000 gross tons and of approximately 792,000 tons deadweight capacity were ordered and built. The increase in general structural strength made the system an ideal one for *"tank"* construction. A further point in favor of the system is that it allows much more hydraulic riveting to be done in the ship yard.

Many authorities speak very highly of turret steamers and consider that they have no equals as carriers of cotton, coal and grain; many steamers of this type use the Manchester Ship Canal, which is a great center for the cotton, grain and coal trade. If one attempted to convey a deck cargo it might get lost, in the *"three island"* deck vessels there is a class of economical workers. The *"long bridge"* vessels are excellent for certain classes of cargo; while *"hurricane deck vessels"* have been found more expensive than the *"three islands,"* but their strong point is their speed. At the present time naval architects are paying more attention to producing vessels of finer lines than heretofore for speed, but they will not necessarily be of high power, those that have been put into use have come up to expectations. The cargo vessel of the near future may combine all the points briefly outlined above.

Emergency Lighting Plants*

By Douglas Primrose

Owing to regrettable accidents, the question of the safety of passengers and crews at sea has recently received the serious consideration of both shipowners and shipbuilders, and one of the many precautions adopted is the fitting of emergency installations of all kinds. In the present brief article it is intended to deal with one of the most important of these, viz., the emergency electrical plant. The design of this installation and the purpose for which it is provided do not appear to be fully appreciated by many of those concerned; and it may be of interest, therefore, to enumerate the various functions such a plant should fulfill, which are as follows:

1.—To operate the radio-telegraph installation.

2.—To supply light to the boat deck and passages and current for the navigating lights.

To meet these requirements in the event of accident when the main source of supply may be cut off through the flooding of stokeholds or other similar cause, the emergency electrical plant must, in the first place, be a complete and self-contained power unit, installed on the boat deck or other point as high above the sea level as possible; and, secondly, it must be capable of being started at a moment's notice, without fail, and run with absolute reliability indefinitely, or as long as it is supplied with fuel. These are, practically speaking, the only two points which the owner or builder requires to consider. Unfortunately, however, there appears to be a tendency to try and make the installation fulfill the duties of emergency and stand-by plant combined. For the emergency installation to fulfill the latter duty in port when the fires are drawn may reduce the running costs of the ship, but such a consideration should not be taken into account at all when it is a question of providing for the safety of life at sea.

This brings us to the consideration of the type of plant most suitable for an emergency set in the proper sense of the term; and from actual experience with both petrol and paraffin-driven plants, the writer has no hesitation in saying that the petrol-driven type is the only one which will meet the requirements in emergency, as it alone can be started at a moment's notice and will run without further attention for considerable periods. On the other hand, the paraffin plant, if started on petrol, necessitates a man standing by to switch over onto paraffin after 10 to 20 minutes' running, with the possibility of changing the fuel too early and consequently stopping the engine, not to speak of the careful adjustment to be made by hand after changing the fuel. It is inconceivable, in the event of a serious accident at sea, that a man could stand quietly by an emergency plant for 20 minutes until the vaporizer was conveniently warm to change over to paraffin; yet in reality this is what the owner who installs a paraffin set is asking of one of his crew.

As regards the question of design, the plant should be as simple and compact as possible, the engine being of a comparatively heavy petrol type, with at least 10 per cent surplus power over that calculated to drive the dynamo at full load. This surplus power is most important as it must be borne in mind that an internal-combustion engine is not by any means so flexible in power as a steam engine. The engine should, of course, be directly coupled to the dynamo, the whole being mounted on one base in the same manner as a steam set.

A considerable divergence of opinion exists as to the system of cooling the cylinder water jackets. There are, of course, one or two types of mechanical coolers for this purpose on the market, but these are rather cumbersome plants, and, in the writer's opinion, hardly suitable for use on board ship where space is valuable. The more common method as used on automobiles, viz., by means of the radiator, is perhaps the simplest. The design of this will vary in accordance with the type used. In certain cases the radiators are fitted outside on the roof of the deckhouse, in which case they are usually of the grilled-tube type. If the vessel is intended to trade in climates where the temperature is likely to fall below freezing point, however, it is necessary with this type of radiator to have some means by which it can be emptied by gravity into a tank, or otherwise the radiator will be damaged by frost.

What is perhaps the most satisfactory method of all is the adoption of a grilled-tube or honeycomb radiator, mounted on the plant between the engine and dynamo. With this type it is necessary to have, in addition, a fan to assist the air circulation. As a rule the fan is driven by means of a belt from some suitable point on the engine. This method, however, hardly appeals to one as suitable for marine work where electricity is available, and perhaps the neatest arrangement is to adopt an ordinary electric bulkhead fan, mounted at the back of the radiator. It must not be overlooked with regard to the deckhouse that plenty of ventilation is absolutely essential, whether the radiator is mounted on the plant itself or outside.

In conclusion, a further remark may be offered in regard to another feature of ship equipment closely associated with the safety of life at sea and which from the mechanical standpoint is almost identical with the emergency electrical plant. The power lifeboat or towing launch is now, if not a necessity, an admitted advantage. Like the emergency set, it must be capable of being started without a moment's delay and run without a hitch indefinitely. For this reason the remarks made above in regard to the fuel for the former apply with almost more force to the engine of the power boat. With the petrol engine there are also the additional advantages of lighter machinery and a greater radius of action with a given weight of fuel.

*From *The Ship Builder*, Newcastle-on-Tyne.

The General Electric Co. has received contract to install electric drive in the battleship California on its bid of $431,000. The machinery will be designed by W. L. R. Emmet, who is responsible for the design of the Jupiter's machinery.

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Light Superstructures*

The Steel Deck Erections Commonly Fitted Above the Strength Deck in Passenger Steamers—Literature on This Subject is Very Scant

By J. Montgomerie

THE subject of superstructures, by which is meant the light steel deckhouse erections now commonly fitted above the strength deck in passenger steamers, has not received, in the preceedings of this and other kindred institutions, that amount of attention which is commensurate with its importance. After an examination of all the available technical literature, the only attempt to deal with the matter which can be found is a paper on large deckhouses, read to the members of this institution in 1913, by Foster King. With this exception, the transactions of this institution are entirely barren of any references, except the most casual and incidental, to this important subject. This paper is an attempt to remedy that defect, and by placing some definite proposals before you, to secure some discussion of the principles which ought to regulate the construction of these houses.

It is evident that, at present, no general principle guides the designer in his work, except that which finds its expression in an endeavor to save the greatest possible amount of material. The subject does not lend itself to mathematical treatment, and scantlings are found to vary widely among different builders to such an extent as to make the deduction of any common denominator almost impossible.

In these circumstances it will be convenient to initiate the consideration of this subject by presenting two alternatives to the designer responsible for the structural design of long superstructures.

(1) The structure may be made so flexible that it cannot take any share in the straining action to which the vessel is exposed as a whole, or

(2) It may be made strong and rigid enough to share that general straining action without damage.

A little consideration will show that the former of these two methods is impracticable. It is to be remembered that the deckhouse carries many heavy weights such as boats, casings and funnels, and that the structure must be sufficiently substantial to support these when the ship is moving in a seaway. It will be recognized that if the superstructure is so flexible that it takes no share in the general straining action, it will certainly not be stiff enough to support the superimposed weights, and the only method by which both these ends may be attained is by cutting the structure at several places, and fitting expansion joints.

The expansion joint is no new idea: So far back as 1878 the late Mr. John told the members of this institution that, if a light superstructure were desired, "it was infinitely better that the superstructure should be severed at different parts of its length to prevent it taking the longitudinal strain in an undue degree than to carry it right fore and aft". In spite of the practical inconveniences involved, these joints are now to be found in very many passenger steamers having long erections. The whole efficiency of the joints, however, in respect of the relief from stress which they afford to a long house, depends on the distance between them, and that in turn states a problem in shipbuilding which has never been satisfactorily solved, viz., the determination of the distribution of stress in way of an abrupt discontinuity, such as a bridge or other erection. If there is a bridge, for example, such as that shown in Fig. 1, built on the continuous ship structure, the material being so disposed as to give the same stress at C as at A, the question is what variation in stress takes place at B, and at what distance *l* from the end of the erection will be found the same principal stress as at A. This distance will evidently be some function of the height H, and will be affected also by the length of the erection. Dr. Bruhn has deduced from some experiments made with india-rubber sheets, having openings or corners cut in them to represent discontinuities, that at a distance 4H from the ends of the bridge "the pull on the upper edge approaches the mean which it would be if distributed equally over the whole of the material". Experiments with a material having semi-elastic properties like rubber do not form a safe guide to a knowledge of the behavior of an almost perfectly elastic material like steel. But, apart from that, there are reasons for thinking this distance 4H to be excessive. In the absence of any theory to which complete assent can be given, we must turn to the record of experience. With this object, as complete an analysis as possible has been made of the cases of damage which have come under observation, and some notes of the principal results of this investigation are presented here as being not only valuable in themselves, but because it is possible to draw certain deductions from them.

(i.) Fig. 2 shows the extent, arrangement and scantlings of the superstructures fitted on a passenger steamer 470 feet in length. A complete promenade deck is fitted above the shelter deck extended to the side, where it is supported by stanchions in the usual manner and forming the top of a deckhouse 275 feet in length. Above the promenade deck is a boat deck which forms the top of a deckhouse 170 feet in length. This vessel, after encountering heavy weather in the North Atlantic, sustained very severe and general damage to the superstructures. The sides of the long deckhouse were cracked for their entire depth at the point marked A. Damage existed elsewhere in the deckhouse sides in the shape of cracked doors and windows. The end connections of the stringer plates and tie plates on the promenade deck had all given way, and these plates everywhere had suffered great deformation between the beams. The main structure of the vessel was absolutely sound.

In this case attention is drawn to the amount of plating fitted on the superstructure decks, to the stiffening of the deckhouse sides, and to the spacing and depth of the webs. The principle of flexibility appears to have been given a trial here. The result was a costly repair in a foreign port and the addition of considerable material, since which no trouble has been experienced.

(ii.) Fig. 3 shows the arrangement of the deckhouses in a vessel 550 feet in length. The length of the superstructure is comparatively small, one tier only being fitted. Doors are fitted at the ends, one 18 feet from

*Read at the spring meetings of the Institution of Naval Architects, March 24, 1915.

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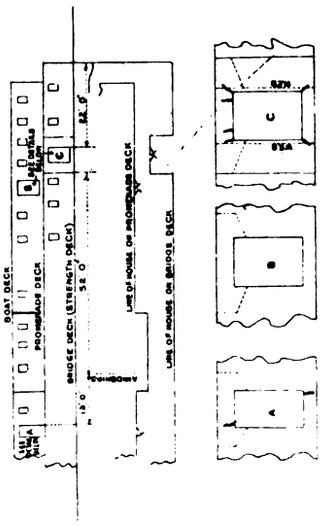

FIG. 4.

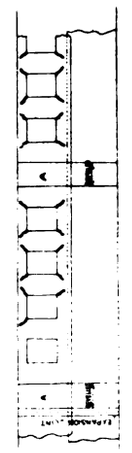

FIG. 5.

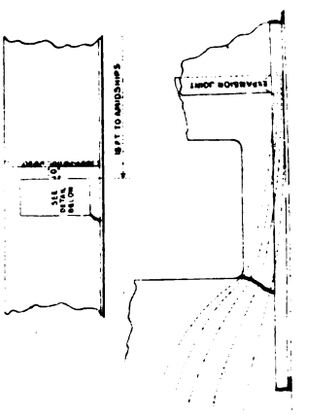

FIG. 6.

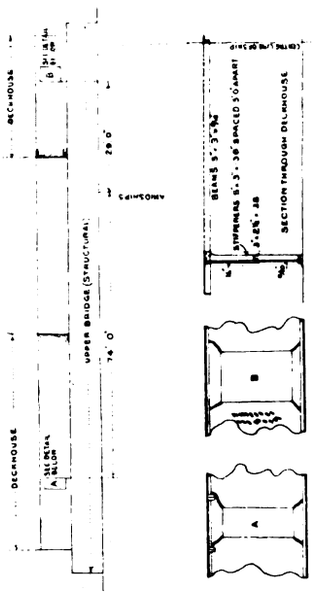

FIG. 3.

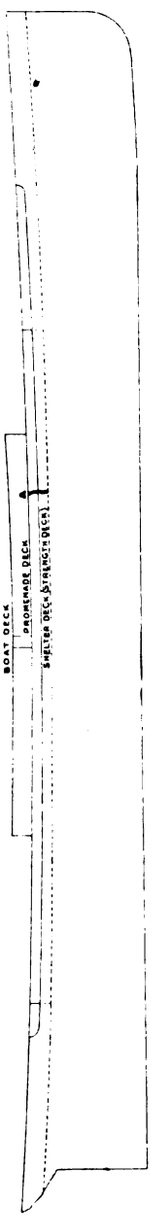

FIG. 2.

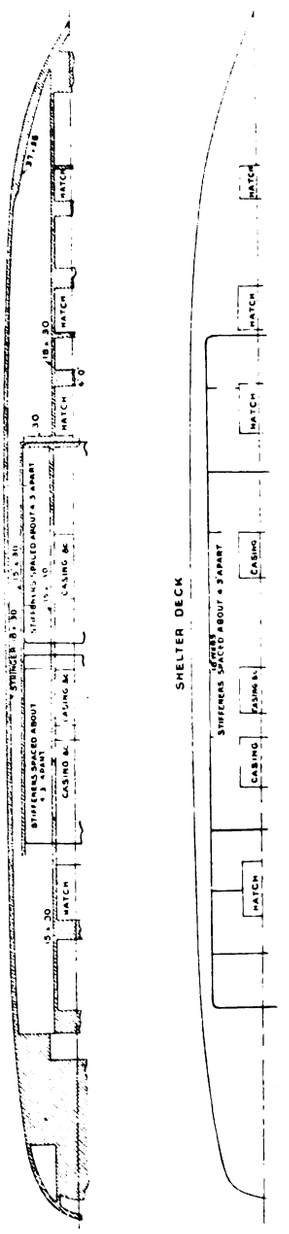

FIG. 1.

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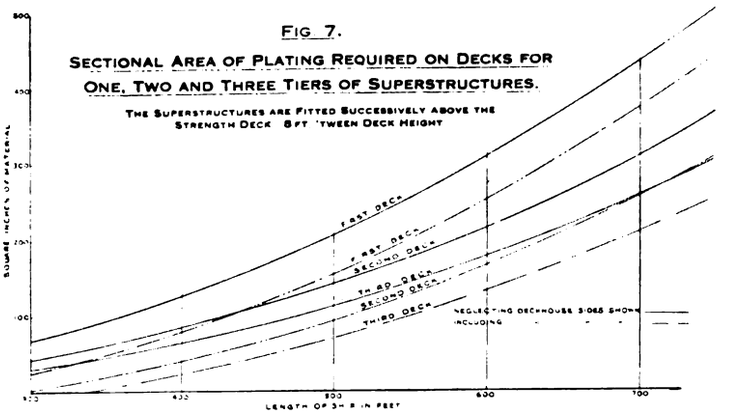
FIG. 7.
SECTIONAL AREA OF PLATING REQUIRED ON DECKS FOR ONE, TWO AND THREE TIERS OF SUPERSTRUCTURES.
THE SUPERSTRUCTURES ARE FITTED SUCCESSIVELY ABOVE THE STRENGTH DECK 8 FT 'TWEEN DECK HEIGHT
FIRST DECK
FIRST DECK
SECOND DECK
SECOND DECK
THIRD DECK
THIRD DECK
NEGLECTING DECKHOUSE SIDES SHOWN INCLUDING
LENGTH OF SHIP IN FEET

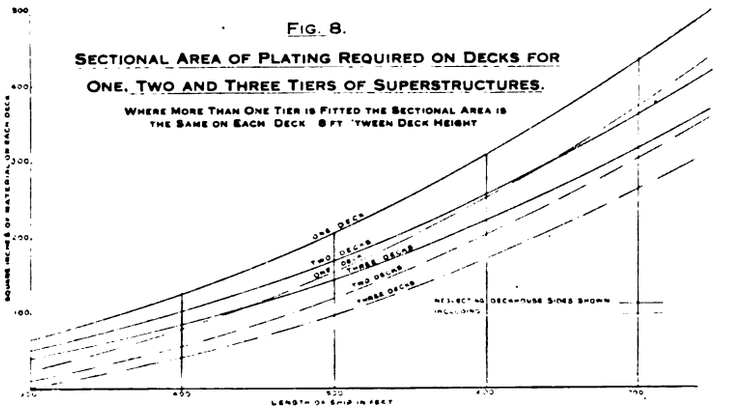
FIG. 8.
SECTIONAL AREA OF PLATING REQUIRED ON DECKS FOR ONE, TWO AND THREE TIERS OF SUPERSTRUCTURES.
WHERE MORE THAN ONE TIER IS FITTED THE SECTIONAL AREA IS THE SAME ON EACH DECK 8 FT 'TWEEN DECK HEIGHT
ONE DECK
TWO DECKS
ONE OF
THREE DECKS
TWO DECKS
THREE DECKS
NEGLECTING DECKHOUSE SIDES SHOWN INCLUDING
LENGTH OF SHIP IN FEET

the after end and one 8 feet from the forward end. No excessive weight is carried above. Damage has taken place as shown. In this case the significant feature is the position of the doors in relation to the ends of the erections.

(iii.) In Fig. 4 is another illustration of the same nature. The length of the vessel is 520 feet, and two tiers of erections are fitted. Damage took place as shown, in this case the door being 22 feet from the end of the house. It may be asked why damage did not take place in way of the opening immediately above. The probable reason is that the stress distribution, in proceeding from the bridge to the boat deck, was such as to produce a greater stress in way of the lower door than above. This was perhaps emphasized by the discontinuity in way of the lower door. Further along the maximum stress would be found at the boat deck (see the door marked A).

(iv.) Fig. 5 shows the effect of discontinuity in the line of the superstructure and also that damage may occur in the proximity of an expansion joint. The sketch shows the middle tier of deckhouses, and the joint is only 6 feet aft of the damage sustained. The corners of the windows shown in the sketch had been cracked, and in the beveled part of the house marked "A," where longitudinal discontinuity occurred, the damage was such as to render it advisable to renew the plate, making it of increased thickness, without windows. I might mention that this is a common feature of superstructure damage, and, as might be expected, wherever discontinuity of the line of the house exists, there is to be found evidence of a concentration of stress. In some cases where there are no openings in the sides of the deckhouse, the deck connections to the strength deck give trouble and require to be renewed and increased in way of such discontinuity.

(v.) Fig. 6 illustrates the state of stress which can exist in close proximity to an expansion joint. In this case the joint was cut in the top tier of superstructures, but not through that below. The probable distribution of stress is shown in the sketch. It may be added that the practice of fitting an expansion joint through part of the depth of the superstructure should be avoided, as the discontinuity at the joint induces severe stress conditions on the house below. In one case which came under observation, the deck of the lower tier had accommodated itself to these conditions by cracking across.

An analysis of the damage observed supports certain conclusions which can be drawn from a consideration of the whole question of superstructures.

These are as follows, viz.:

1. That in way of a discontinuity in the structure of a ship, for example, in way of a bridge or superstructure, stresses outside the erection will be transmitted to the material of the deeper girder in way of the erection much more rapidly than has been thought to be the case.

2. That, consequently the fitting of expansion joints, spaced as in the present practice, does not appreciably relieve the superstructures of stress or obviate damage.

It may be observed that various explanations of this damage, more or less vague, are advanced from time to time. For example, the ship is spoken of as "shouldering her way through a sea"—a combined action of twisting and bending being implied—and it is a well-known fact that the maximum stress resulting from such a combination is greater than that due to either of its components taken singly. But the straining actions to which a superstructure is exposed do not differ in their nature from those sustained by the ship itself. In the latter case it has been the custom to divide the straining action into its component parts, and to deal with each separately. There does not appear to be any reason why the satisfactory results obtained by this method in the case of ships' structures should not also be obtained when applied to the superstructures. It follows, therefore, that—

3. The best method of providing against damage in deckhouse superstructures is to adopt the latter of the two alternatives mentioned in the fifth paragraph of this article, and to dispose the material so as to make these capable of taking part in the straining action of the hull, following as far as possible the general law that all discontinuity of longitudinal material should be minimized.

The second part of this paper is an attempt to determine, over a sufficiently wide range, the scantlings of deckhouses, so that they shall be able to take their share in the general straining action of the hull. So far as the longitudinal material is concerned, the principle adopted is the common one that the stress for which the ship was designed shall not be exceeded at each tier of houses.

Certain typical cases were taken, ranging in length from 300 to 750 feet, their scantlings determined as required by the rules of Lloyds Register, and the modulus of the section

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calculated. Then, from the fundamental equation—

$$\frac{p}{y} = \frac{M}{I}$$

we have—

$$\log p - \log y = \log M - \log I,$$

and—

$$\frac{1}{p}.\,dp - \frac{1}{y}.\,dy = -\frac{1}{I}.\,dI, \text{ since M}$$

is constant and dp is negative,

$$\text{if } \frac{dI}{I} \text{ is greater than } \frac{dy}{y}.$$

Then, if a square inches of plating, placed at a distance h feet above the top of the girder, is such as to secure the same modulus of section as calculated for the typical cases mentioned above, it can be shown that—

$$a = \frac{K.\,h.\,A}{A\,(y + h)^2 + I}$$

where—

K = modulus of section $\left(= \frac{I}{y}\right)$ in sq. ft.

A = sectional area of material in sq. in.

I and y are values for original section.

On this basis Fig. 7 shows the amount of material required, calculated on the assumption that first one superstructure is added, and the material required determined, then another superstructure added, and the material again determined, allowance being made in each case for the material already fitted. This involves rather an uneconomical use of the material, and accordingly Fig. 8 shows the amount of material necessary on the assumption that the sectional area on all superstructure decks be made the same. This secures some saving in the material which would give the same modulus of section when taken to the top of the superstructure as when taken to the strength deck. This is a compromise which does not appear to be unreasonable. A consideration of longitudinal strength alone would necessitate the material being concentrated on the top tier, while a consideration of the transverse strength alone would require it to be a maximum on the tier immediately above the strength deck. In these circumstances, no great error will be made by placing the same amount on all decks.

The effect of changing the proportion of length to depth has been investigated, and it is found that any alteration between the limits $-\frac{L}{D} = 10$ and $-\frac{L}{D} = 13$ makes very little difference in the amount of material as given in Fig. 8. The height of deckhouse, however, which as is well known, varies considerably in practice, has an appreciable effect in altering the amount of material required. The effect has been investigated, and the result is shown by the curves given in Figs. 9, 10 and 11. Fig. 12 continues this information in a series of curves plotted isometrically, showing height of superstructures, length of ship, and amount of material required, the effect of the deckhouse sides being neglected.

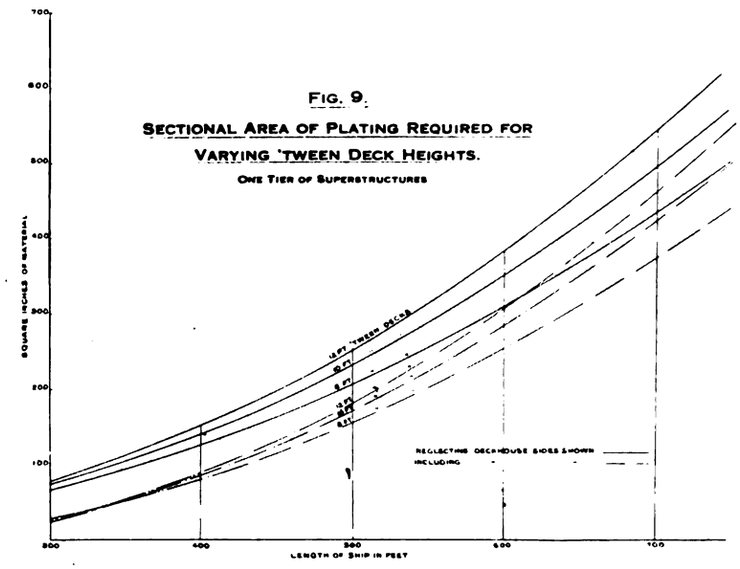

FIG. 9.
SECTIONAL AREA OF PLATING REQUIRED FOR VARYING 'TWEEN DECK HEIGHTS.
ONE TIER OF SUPERSTRUCTURES

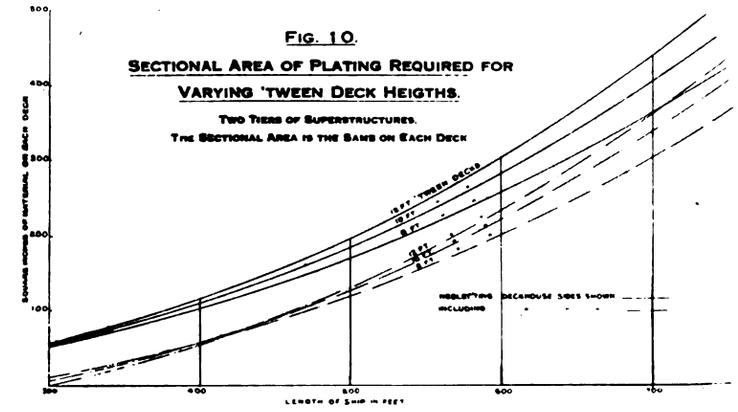

FIG. 10.
SECTIONAL AREA OF PLATING REQUIRED FOR VARYING 'TWEEN DECK HEIGTHS.
TWO TIERS OF SUPERSTRUCTURES.
THE SECTIONAL AREA IS THE SAME ON EACH DECK

The determination of the amount of transverse material to be employed is much more complicated than that of the longitudinal material. The transverse stiffening must be efficient to transmit the superimposed weights to the hull, it must also be rigid enough to transmit to the strength deck the impulsive forces set up by the motion of the vessel in a seaway, and it must be such as will make the longitudinal material stable under compressive stress. Under these conditions, to attempt any detailed analysis is impossible. It seems reasonable, however, to suggest that the impulsive forces, due to the motion of the vessel, should be entirely taken up by the series of deep webs now commonly fitted at more or less frequent intervals, while the stiffeners should be designed simply for local work. If this proposition be assented to, there appears to be an additional reason for fitting a substantial amount of plating on each deck, for it will be by means of this plating that the impulsive forces will be transmitted to the webs. In much of the present practice this is done by means of a narrow flexible stringer plate, not at all a suitable means of distributing these forces to the webs.

If the webs be assumed to take all the impulsive forces, some idea of the necessary spacing may be obtained as follows:

From the general and well-known equation—

$$I\,\frac{d^2\theta}{dt^2} + M.\,g.\,l.\,\sin\theta = 0,$$

where I is the moment of inertia of the vessel about an axis passing through

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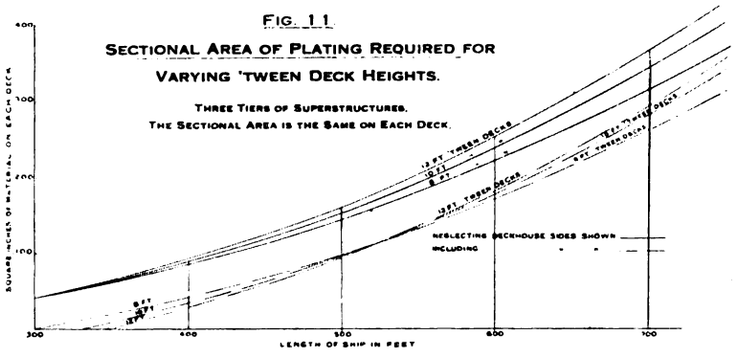
SECTIONAL AREA OF PLATING REQUIRED FOR VARYING 'TWEEN DECK HEIGHTS.
THREE TIERS OF SUPERSTRUCTURES.
THE SECTIONAL AREA IS THE SAME ON EACH DECK.
NEGLECTING DECKHOUSE SIDES SHOWN
INCLUDING
LENGTH OF SHIP IN FEET

FIG. 11.

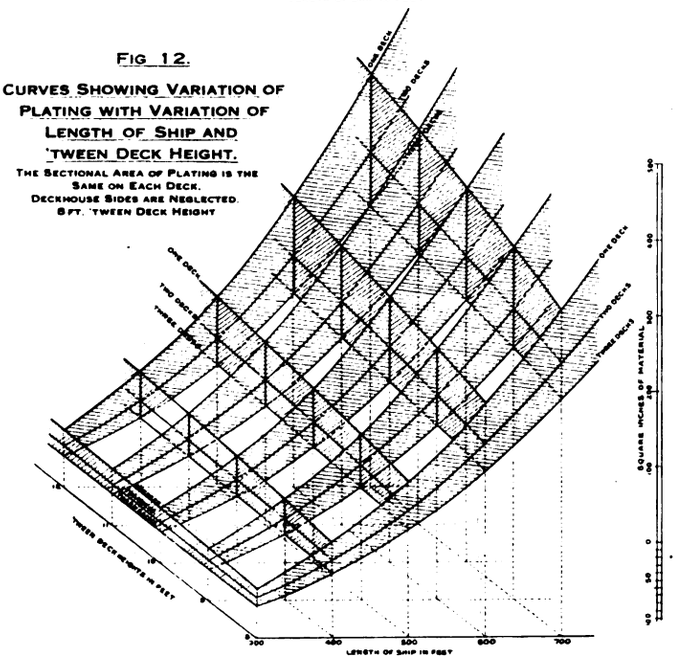
CURVES SHOWING VARIATION OF PLATING WITH VARIATION OF LENGTH OF SHIP AND 'TWEEN DECK HEIGHT.
THE SECTIONAL AREA OF PLATING IS THE SAME ON EACH DECK.
DECKHOUSE SIDES ARE NEGLECTED.
8 FT. 'TWEEN DECK HEIGHT
ONE DECK
TWO DECKS
THREE DECKS
SQUARE INCHES OF MATERIAL
'TWEEN DECK HEIGHTS IN FEET
LENGTH OF SHIP IN FEET

FIG. 12.

the center of oscillation, and l = the metacentric height.

For small values of θ—

$$\frac{d^2\theta}{dt^2} = \frac{g.l.\theta}{K^2}$$

where K is the radius of gyration about the same axis.

And, since the time of a single roll

$$T = \pi \sqrt{\frac{K^2}{g.l}}$$

$$\therefore \frac{d^2\theta}{dt^2} = \frac{\pi^2}{T^2}\theta.$$

Take any element of the erection of mass m at a distance x from the center of gravity, which is supposed to be contained in the axis of oscillation, then the linear acceleration of the mass m at the end of a roll is—

$$\frac{\pi^2}{T^2}\, a.\ x \text{ ft./sec.}^2,$$

where a is the mean angle of roll. Therefore force on m is—

$$m\,\frac{\pi^2}{T^2}\,.a.\,\frac{x}{g}\ ,$$

If this expression be integrated over a definite length, it is possible for a given period and angle of roll to obtain an idea of the forces acting on that length. The transmission of these to the hull proper implies bending moment and shear forces in the material of the webs and shear and pull forces in the rivet material attaching the webs to the deck. From certain actual cases, and assuming a mean maximum roll of 25 degrees and a time of single roll of 6 seconds, Fig. 13 shows the spacing and depth of webs plotted on a base of length of ship which will give a principal stress not exceeding 9 tons per square inch in the rivets in the double angles connecting the webs to the strength deck proper. The remainder of the transverse material, i. e., the vertical supports to the sides of the house and the beams, should be dealt with on the assumption that they are local stiffeners only. When the sides of the house are included for longitudinal strength, the principal function of the stiffeners is to support the plating under compressive stress. In that case their spacing should be the same as that of the main frames, and on Fig. 14 are suggested the moduli of various sections which have been based on what has proved satisfactory in superstructures and on experience of topside material supported by light scantling frames. Fig. 14 also shows the mean thickness of deckhouse side plating adopted in conjunction with these stiffeners. When the sides of the superstructure are not considered for longitudinal strength, the stiffeners may be spaced more widely apart. In regard to the beams, the element of load should not, of course, be the determining factor. Their spacing will depend on the arrangements adopted, the thickness of the deck plating, the fitting of a wood deck, the fitting of girders, etc. In general, for ships below 550 feet in length the beams could be fitted to alternate frames, and Fig. 15 shows the moduli of beams of suggested scantlings for an unsupported length of 18 feet. The moduli of the beams may be taken to vary directly as the unsupported length. It does not appear to be difficult to design a more economical arrangement of the material in the beams than has been adopted hitherto for use in large public rooms where a minimum number of pillars is desired. If strong beams be fitted uniting the webs on the sides of the house it is possible to have between them a combination of light girders and beams of reduced scantlings. The beams could be uniform in scantlings throughout the superstructures for the same unsupported length.

The scantlings of superstructures based on the foregoing considerations have been determined for some cases, and these are shown in Figs. 16 to 20 inclusive. These give a clearer idea of the amount and arrangement of the materials in the superstructure than can be obtained from the various tables and curves supplied. It will be observed that in these cases the deckhouse sides are included as part of the longitudinal materials, a method of procedure which should be adopted wherever reasonably possible. When the sides of the house are so included, any openings cut in them should be compensated for in an efficient manner. Windows should have well-rounded corners of a radius of at least 4 inches, and the material in way of the windows should be made up to equal the amount required by Fig. 14. In those instances where the deckhouse sides cannot be made effective for longitudinal strength, where large doors are fitted, for example, the opening should extend the whole depth of the house, and a wood frieze and coaming should be arranged for at the top and bottom of the door. The structural material on the deck should, of

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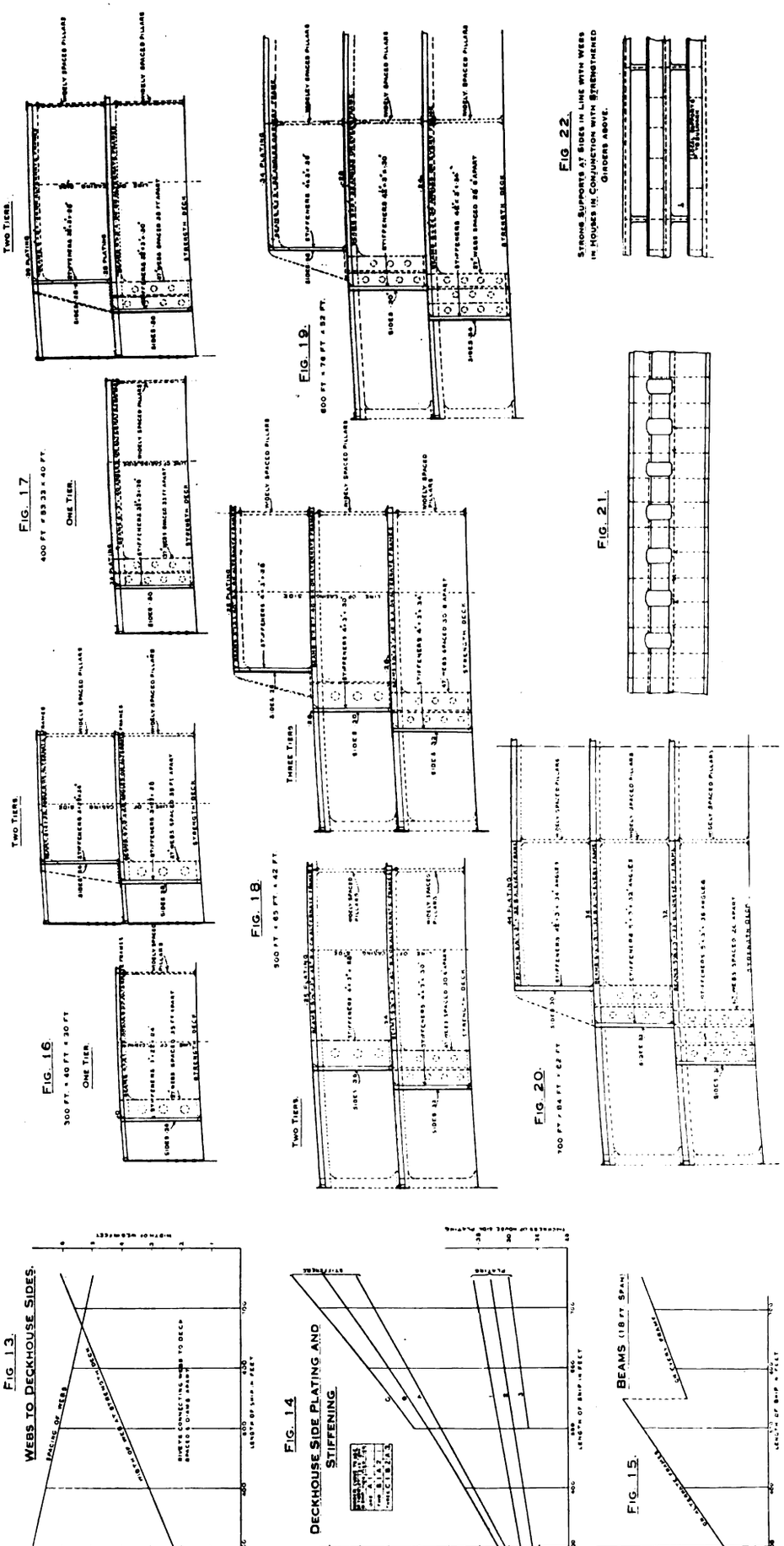
FIG. 17
400 FT. × 83 FT. × 40 FT.
ONE TIER.
FIG. 19.
800 FT. × 78 FT. × 82 FT.
FIG. 22.
STRONG SUPPORTS AT SIDES IN LINE WITH WEBS IN HOUSES IN CONJUNCTION WITH STRENGTHENED GIRDERS ABOVE.
FIG. 21.
FIG. 16
300 FT. × 60 FT. × 30 FT.
ONE TIER.
FIG. 18.
900 FT. × 85 FT. × 42 FT.
THREE TIERS.
TWO TIERS.
FIG. 20.
700 FT. × 84 FT. × 62 FT.
TWO TIERS.
FIG. 13.
WEBS TO DECKHOUSE SIDES.
FIG. 14
DECKHOUSE SIDE PLATING AND STIFFENING
FIG. 15.
BEAMS (18 FT. SPACE)

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trains, considering delays in loading and unloading the latter. At the low rates charged, in order successfully to compete with the railroads, the Alabama & New Orleans company has found the operation of the barges profitable.

Coal from the Alabama fields, for instance, has been laid down by these barges in New Orleans to sell for $3 per ton, against $3.50, the lowest figure at which it can be sold when brought by rail. The freight rate on pig iron from Holt, Ala., to the mills in Mobile, has been reduced from $2.75, by rail, to $1.25 by barge, per ton.

The new 3,000-ton barges, intended for more extended service, will be exact replicas of the 1,000-ton barges now in use, save that they will be three times as large and three times as strongly powered. Material for them is now in the shipyards at Violet, 12 miles from New Orleans, where the first big power craft were built. A special plant has been erected at Violet, at the Mississippi river entrance of Lake Borgne canal, for the building and repair of the 1,000-ton barges, and it will be used also for construction of the "biggest power boats in the world," as Mr. Bernhard calls his new barges.

Each of the 1,000-ton power freighters is built entirely of steel, 240 feet long, 32 feet beam on deck and 28 feet on the nearly flat bottom, by 8 feet draught on the sides and 8½ feet in the center. Her draught is 6 feet when loaded to capacity. The barge is propelled by twin screws, driven by twin Fairbanks gas-producer engines of 75 horsepower, each. Their maximum speed on a straight course with no current is 8 miles per hour, though down stream they have made as high as 10 miles, and against the current as low as 4½. The average, loaded, is about 6 miles. The engines are vertical and capable of being disconnected from the propellers and used to furnish power for handling cargo, etc.

Gas for the engines is derived from breeze coke, put through a producer carried on board. Average fuel cost is only $1.80 per 12-hour day. The engine room contains, desides the two motors, a producer, scrubber, saturator, evaporator, gas tank, tar extractor, electric light plant, and bilge pumps. The approximate cost of each of these 1,000-ton barges is $30,000, of which nearly $10,000 is expended on engines and engine room appurtenances. The fleet of 15, which is in process of building—six having been completed—will cost between $450,000 and $500,000, not comparable with the cost of the projected fleet of 20 3,000-ton barges, yet the largest sum of money yet put into a power boat venture in the United States, if not in the world.

Six men are required to operate the barge 24 hours a day. This crew is divided into two "shifts" composed of captain, engineer and deckhand. In Holland, according to Mr. Bernhard, two men operate this sort of craft, but more men are used here on account of the tortuous courses of the streams which have to be navigated, as compared with the broad, straight, open canals of Holland. Roomy cabins in the forepeak house the crew. No cargo is carried below the deck, all of that space being utilized for engine-room and quarters for the crew, whose cabins are supplied with electric fans, electric lights and air scoops.

Aft, above the engine room, is the bridge and pilot house. From this, the captain is able to control everything—engines, steering gear, reverse gear, and even the dynamos. The steering wheel works three rudders, the middle one being balanced and independent of the other two.

Two 1,000-ton power lighters, similar in construction to the barges, save that a huge belt conveyor, working under hoppers in the deck and up over an elevator sufficiently long and flexible to reach into the hold of the largest liner, have been constructed in New Orleans and have made great saving in the coaling of steamers in midstream. These lighters travel under power from engines similar to those in the barges, and which, when at rest furnish power for the conveyor and elevator. The lighters, however, have three engines, and triple, instead of double screws. Such lighters are able to lie alongside the largest ships, in midstream, and as the coal drops from the cargo box of one of the 1,000-ton barges, deposit it immediately and directly into the bunkers of the steamer.

Our Chief Naval Constructor

The following appreciation of David W. Taylor, chief constructor of the United States navy, from *Engineer*, London, will be read with pleasure by every American:

The appointment of David Watson Taylor, on Dec. 14, as new chief constructor of the United States navy, is of particular interest to Englishmen, because Mr. Taylor received much of his education at the Royal Naval College, Greenwich, whither he went for the three years' course in naval architecture, which he completed in 1888 with, we are told, the highest marks for the naval architecture course ever received by any English or foreign student either previously or since that date.

Mr. Taylor is well-known professionally on this side of the Atlantic by his writings, which have been frequently discussed in these columns. In 1894 he was awarded a gold medal by the Institution of Naval Architects for his paper on "Ship-shaped Stream Forms," and seven years later won the first prize offered by the American Society of Naval Architects and Marine Engineers, in an anonymous competition, for the best paper on "Theoretical and Practical Methods of Balancing Marine Engines."

In this country he is best known by his experimental work at the Washington tank. It would take some time to enumerate the various papers which he has written from year to year covering some of the results of his investigations. His researches cover the many problems of screw propulsion and hull forms, together with the flow of water under a ship and the question of suction between passing ships. Indeed, it will be remembered that he was an expert witness in behalf of the Admiralty during the hearing of the Hawke-Olympic case. In his own country, Naval Constructor Taylor's writings upon suction between ships compelled the Admiralty courts of that country to give recognition to this perturbation in cases of collision where, previously, arguments to that effect had been looked upon by the legal fraternity as an excuse for careless navigation.

His best-known books are "Resistance of Ships and Screw Propulsion," published in 1894, and "Speed and Power of Ships," printed in 1910, both of which may be looked upon as standard works. While in charge of the Model Experimental Basin, in fact, during the past 20 years, Mr. Taylor has taken a very active part in the designing of all ships for the United States navy, and their efficiency and economy of coal consumption are largely the result of his labors. It is to him that the all-center-line disposition of the main battery of American battleships owes its origin.

The Tucker, one of the largest torpedo boat destroyers built for the United States navy, was launched from the Fore River yard May 4. The Tucker measures 315 feet over all, with a beam of 20 feet 10 inches and depth 17 feet 7 inches. The displacement is 1,090 tons and the horsepower 17,000.

The Tucker is named for Commodore Samuel Tucker, who served in the wars of the Revolution and of 1812. Mrs. William Garty, of Brookline, a lineal descendant of the commodore, acted as sponsor.

The Cuba Distilling Co. has placed an order with the Fore River Ship Building Co., Quincy, Mass., for a bulk freighter for the West India molasses and petroleum trade. She will be a practical duplicate of the Nelson.

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Lubrication for Propeller Shafts

In marine, as indeed in all other engines, the question of efficient lubrication is highly important, and while most of the parts of a marine engine have received attention and are quite generously looked after in this respect, the propeller shaft has been largely left to look after itself, with such help as it may get from outside sources, and when vessels are working in muddy waters the withdrawal of the shaft and the renewal of the stern bush bearings becomes a too frequent job.

The system of lubrication described herewith by the *Marine Engineer and Naval Architect*, London, is one that was jointly devised and patented by T. W. Jacobs Jr. and F. J. Mayor, of the Thames Steam Tug & Lighterage Co., Ltd., to overcome the difficulty experienced on the tugs belonging to this firm, as the repairs consequent upon the wear in stern bush and propeller shafts, were so considerable that it was desirable that an efficient and simple means of lubrication should be found, which at the same time would prevent the entrance of gritty water to tear the shaft.

Having regard to the frequency with which it was found that the propellers were fouled with ropes, chains, etc., in the river, it was recognized that any device dependent on the use of an outside gland fitted in the usual way, was doomed to failure. It was therefore decided to permit the lubricant to escape at the after end of the stern bush.

Broadly, the principle of the contrivance is the lubrication of the shaft by a semi-solid lubricant, fed slowly, continuously and automatically to the forward end of the stern tube and then exuded, after it has done its work, at the after end.

It will at once be seen that the constant outward flow of grease will also prevent, to any considerable extent, the inward flow of water with its attendant ill-effects, especially where full of mud.

Referring to the illustrations, Fig. 1 shows the apparatus as fitted to a tug, for which it was originally designed. For larger vessels it would be designed in proportion to the size of the shaft. The lubricator is here shown attached to the after bulkhead, with a tube led away and entering the forward end of the stern tube. The lubricator is actuated by a ratchet and pawl driven by an eccentric attached to the propeller, or to the intermediate shaft as may be convenient. The grease is pressed through the tube to

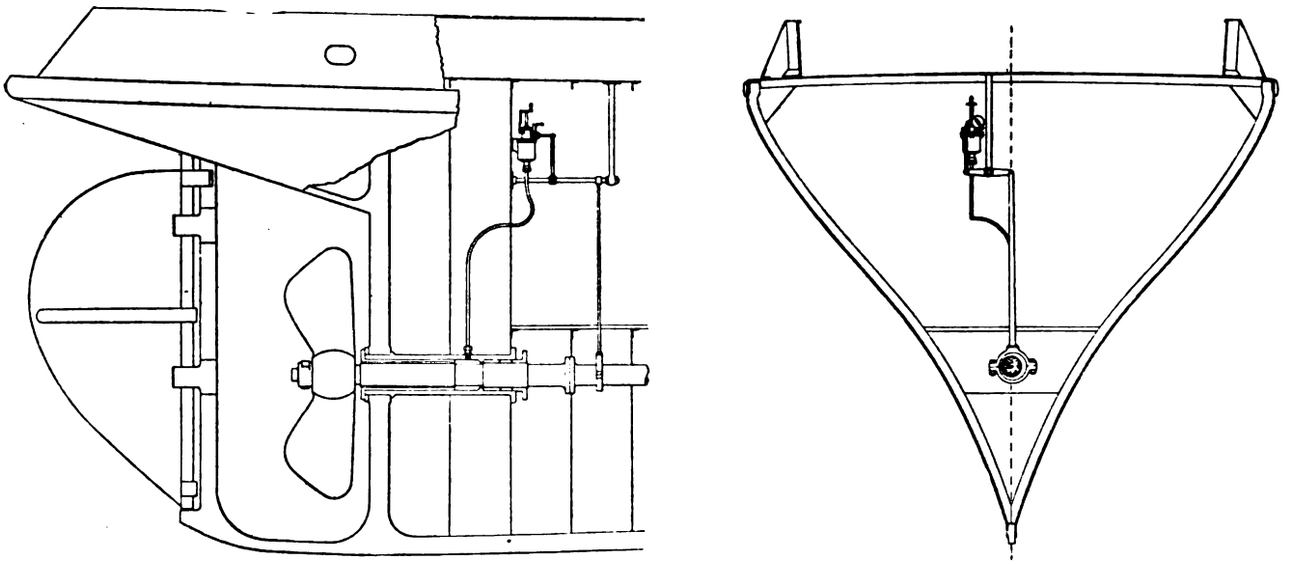

FIG. 1

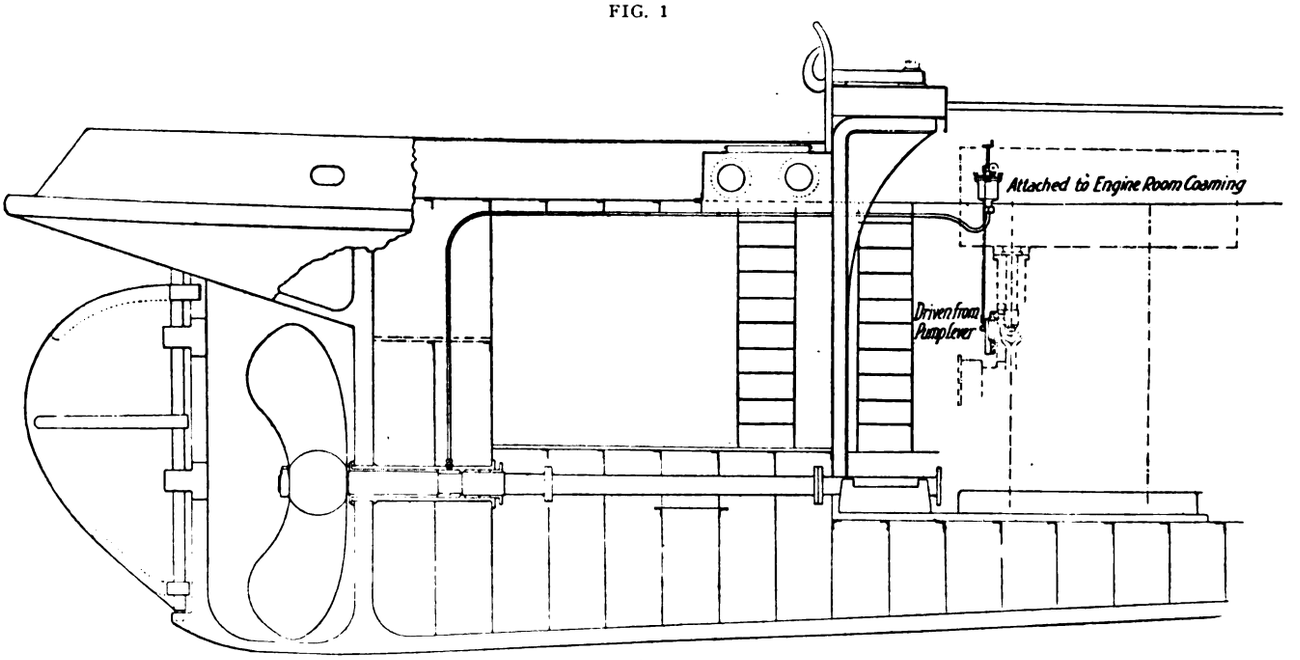

FIG. 2

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the shaft and the bearings are thus kept well lubricated from the stuffing box at the fore end to after end, where it escapes. It was imperative that the feed of the grease should be very slow and only sufficient for the purpose. A special lubricator was therefore devised to give a slow and powerful feed, with a wide range of adjustment —a great advantage when charging the system, or when it is desired to give an extra rapid feed. The automatic nature of the feed is essential for proper lubrication, and, being positive and continuous in action, it meets a cardinal point in any system that aims at proper lubrication.

This is brought about, as shown in Fig 1, by an eccentric on the shafting, or as in Fig. 2, by being driven directly from some reciprocating part of the engine as, for instance, the pump levers. It is thereby ensured that a positive and regular feed of grease is made for every stroke of the engine, and it is impossible for the engine to move either ahead or astern without positively forcing a certain amount of grease through the stern tube. The human element is thereby eliminated to a very great extent; it is only necessary for the attendant to occasionally refill the grease container, which, in the smaller steamers already fitted, is at intervals of between two and three weeks, the cost of the lubricant for this period being approximately three shillings. The lubricator has been so designed that the recharging may be done with a minimum of trouble; it only being necessary to disengage the pin in the ratchet lever, slacken back the butterfly nuts and remove the vent screw, when the whole cover and gear can be lifted off bodily, giving access to the container for refilling. If it is considered desirable to give a rapid feed, as, for instance, just after recharging, means are provided for doing this by interrupting the double train of worm gears by means of the eccentric shown in the sectional view of the lubricator, Fig. 3.

The means for stopping the feed at the end of the travel of the plunger is arranged to preclude any chance of failure from this cause. Special attention also has been given to the design of pawl, as it is important that the pawl action should be reliable, and reliability of working has been the guiding principle in designing the whole arrangement.

That there is ample power to forcibly feed against any head of water may be presumed, when it is known that the mechanical advantage in the complete train of gear is such that, in the lubricators at present fitted and feeding at the slowest speed, it needs 125,000 revolutions of the engines to obtain 1-6-inch travel on the lubricator plunger. This can be speeded up to give automatically 5-6-inch travel on the plunger for the same number of revolutions and a feed of 53.5 inches through the tube connecting with the stern tube. In the vessels now fitted it has been found that the wear of the bushes is less than half and the wear on the shaft is imperceptible, the shaft in the way of the stern bush being in a highly polished condition.

The advantages and economies that follow from efficiently lubricating this most important part of marine machinery are manifest. Most marine engineers have had experience of the troubles that arise from the want of proper lubrication and the results obtained in the vessels referred to prove the great advantage of the system of lubricating the propeller shaft in the manner described.

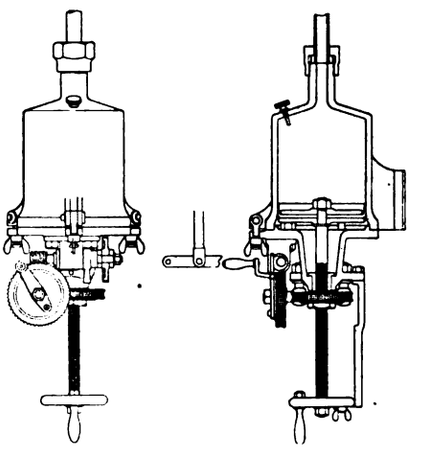

FIG. 3

Coast Ship Building

Shipyards on the Delaware river have many large orders in hand. Two more contracts for large steamships have been awarded the Harlam & Hollingsworth Corporation, of Wilmington, making the total contracts awarded to Delaware river shipbuilders for vessels now building or to be built, more than 30. The two contracts awarded on Wednesday were for tankers, one to be built for a foreign corporation, namely, the Anglo-Saxon Petroleum Co., of London. Each of the vessels will cost about $780,000.

The other tanker is to be built for the Mexican Oil Co., of New York, is to be delivered in 13 months, and will cost about $750,000. The same shipping company has under construction one car float, one oil barge and one steel ferry hull.

Another Delaware shipbuilding concern which is working to capacity is the New York Shipbuilding Co., at Camden, N. J. This corporation has 8,000 men in its employ, and holds contracts for five colliers for the Coastwise Transportation Co., of Boston; the battleships Idaho and Oklahoma for the United States navy, torpedo boat destroyers Ericson, Jacob Jones and Wainwright, and the submarine tender Melville. Besides these, a large lumber steamship for the Atlantic coastwise trade, the William O'Brien, is just completed, and a large tanker for the Gulf Oil Co. was recently launched.

The Cramp Shipbuilding Co., another Delaware shipyard, has under construction no less than seven torpedo boat destroyers for the United States navy, two large cargo-carrying steamships for W. R. Grace & Co., of New York, a steel yacht for Henry Whitney, of New York, and an oil tanker for the Huestica Oil Co., of New York.

The Jackson & Sharp yards at Wilmington, Del., are building eight seagoing barges, one towboat and five dump scows. Other smaller shipyards along the Delaware are also busy at work on from one to three sail or unrigged vessels.

The Fore River Shipbuilding Corporation at its own request is spending $250,000 in putting in much stronger turbines than at first built for the battleship Nevada, under construction at its yards. This step was taken by the shipbuilders because of the unpleasant experience with the Curtis turbines which the company built and installed on the Argentine battleship Ravadavia, when it was found that the buckets were not strong enough and the metal was seriously weakened by the superheated steam. The corporation is willing to shoulder the expense rather than stand a chance of having to tear out the turbines and repair or remodel them after the ship is ready for service.

The Fore River Co. has been awarded another contract for a tanker by the Cuban Distilling Co. This vessel is to be used in the transportation of molasses from Cuba to American ports. The award makes the third vessel to the Fore River Co. by the same corporation.

John S. Talbot, general agent of the Chicago & North-Western railway, with headquarters at Indianapolis, has been selected as commissioner for the Association of Lake Lines with headquarters at Buffalo. Mr. Talbot succeeds Fred Signer who resigned to become general eastern freight agent of the Lehigh Valley railroad.

The steamer E. D. Carter, which was last year purchased by the Algoma Central Steamship Line from Edward Carter, Erie, Pa., has been sold to Boland & Cornelius, Buffalo.

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THE MARINE REVIEW

DEVOTED TO MARINE ENGINEERING, SHIP BUILDING AND ALLIED INDUSTRIES

Published Monthly by

The Penton Publishing Company

Penton Building, Cleveland.

CHICAGO	1521-23 Lytton Bldg.
CINCINNATI	312 Johnston Bldg.
NEW YORK	507 West Street Bldg.
PITTSBURGH	2148-49 Oliver Bldg.
WASHINGTON, D. C.	206 Corcoran Bldg.
BIRMINGHAM, ENG.	Prince's Chambers

Subscription, $2 delivered free anywhere in the world.
Single copies, 20 cents. Back numbers over three months, 50 cents.

Change of advertising copy must reach this office on or before the first of each month.

The Cleveland News Co. will supply the trade with THE MARINE REVIEW through the regular channels of the American News Co.

European Agents, The International News Co., Breams building, Chancery Lane, London, E. C., England.

Entered at the Post Office at Cleveland, Ohio, as Second Class Matter.

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June, 1915

The Sinking of the Lusitania

If we set aside the Carmania as an experiment in large units, the Lusitania was the first of the giant liners to be equipped with turbines, and though the Mauretania exceeded her somewhat in displacement and speed, the Lusitania as the pioneer held first place in our esteem. She had carried thousands of Americans to Europe on business and on pleasure and she had brought them safely home again. During the nine years of her existence she had become a part of our national household and her graceful form was a familiar object in the greatest of our harbors. There is something about a ship that creates affection such as no other inanimate object can inspire. She is the greatest triumph of man's constructive abilities and it might with modesty be recorded that nothing finer as an example of man's handiwork existed in the world than the Lusitania.

While engaged in peaceful passenger traffic without arms or munitions, without convoy, without power of offense or defense, this splendid creature of the sea was sunk by a German submarine off the coast of Ireland and over 1,200 persons who were traveling well within their natural rights and who were violating no canon of international law, either of peace or war, were drowned. It is difficult to conceive of anything more horrible than this act of premeditated wholesale murder. Whole families were sent to their account without the slightest chance of escape, for the Lusitania had headway on her when she sank, and it was impossible to launch the life boats. What manner of man must that German commander have been that he should have sent so deadly a missile against the undefended sides of a ship freighted with such cargo. No amount of persuasion or coercion, no threats or entreaties, no power on earth could ever make an American or English commander do a deed like that.

It is obviously impossible that an outrage so colossal as to shake the moral fiber of a man to its roots can go unchallenged. No nation under heaven can suffer the lives of its women and children to be ruthlessly extinguished. Nations are judged by the times through which they pass and the verdict of posterity is inexorable. Our conduct on this occasion must be such as to preserve our national self-respect or the pages of our history will be blotted with a shameful record.

A deed has been done that has made the whole world ashamed of its perpetrators. Of that there is no doubt whatever. The feeling in this country is one of deep resentment. The fact is that the act has violated our innate sense of the fitness of things. Germany is on trial at the bar of every man's conscience. Our sense of primal justice surmounts and survives all other emotions, and in the end it always triumphs. Therefore the sinking of the Lusitania was the greatest military blunder that Germany could create. It has not intimidated Great Britain, but has increased her resolution; it has not alarmed neutral countries, but has alienated and incensed them.

We do not believe this country will go to war over the affair. War will not restore the lives that were sacrificed on the Lusitania; but it is important that Germany must be made to understand that American citizens have the right to travel on the high seas unmolested, whether traveling on enemy or neutral ships when these ships are engaged in peaceful passenger traffic, and every other neutral country should take the same stand in relation to its own citizens. Then if Germany chooses to conduct herself as an outlaw she should be treated as one, and all diplomatic relations with her severed.

Meanwhile is it not the height of folly that we continue a policy that deprives us of ships?

The season of 1915 on the Great Lakes bids fair to be a good one. It opened somewhat earlier than was expected and is steadily growing throughout May. June will probably experience a marked impetus, as the new rail rate from the Mesabi range is to be put into effect on the first of the month. There are pronounced indications that the ore shippers expect a good movement of ore. The volume of the country's business is growing and activity is not confined to any particular line of industry. Merchant shipbuilding, almost a lost art, has suddenly revived on the Atlantic seaboard. No yard is without orders and some have all that they can attend to during the next two years. Approximately 35 orders have been distributed among the Atlantic coast yards.

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Steering Gearings on the Lakes

In the narrow waterways congested with traffic such as the rivers and channels of the connecting waters of the Great Lakes, no part of a vessel's equipment is of more vital importance in the search for "Safety First" than her steering gear. That it should be staunch and reliable in every emergency is a cardinal principle of safety, and as even steering gears of the best design and construction are liable to break down or become temporarily deranged, leaving the vessel out of control of her master and pilot, an auxiliary gear of some kind has for a long time been regarded as an essential.

While Great Lakes vessels were of moderate size, a hand wheel on the after house was regarded as sufficient, but while this gear might be effective in controlling the smaller vessels in the open lake, it was realized that in close waters it would be impossible to throw it into gear and man it in time to avoid stranding or collision in the rivers. It was further realized as vessels of larger tonnage were built and put into commission that in a seaway in the open lake the kick of the rudder would probably make this hand wheel uncontrollable, even by all the men it would be possible to crowd around a double steering wheel. This latter objection was met for a time by gearing the hand wheel on the after house direct to the controlling valve of the steering engine, thereby enabling the steam gear to be used, provided always that the breakdown had affected only the transmission from the pilot house, and had left the steering engine intact. But this slight improvement still left open the possibility of complete loss of control of the vessel if any accident should occur that would put the steering engine itself out of commission or affect the steering chains and sheaves that at that time were used to connect the steering engine to the quadrant.

In 1909 the technical staff of the Great Lakes Engineering Works worked out and perfected a design to eliminate at one stroke the steering chains, sheaves and quarter blocks that had in all former arrangements interposed between the engine and the quadrant, and which had always been a source of trouble, danger and expense, due to lost motion, breaking of chains, cutting of sheaves, etc. This new design was first used on the steamer North Sea, which was built at the Ecorse yard of the Great Lakes Engineering Works in 1909 for the Mutual Transit Co. In this installation the steering engine was placed on a built-up foundation on the fantail and the motion of the steering engine was transmitted through a pinion on the engine direct to a toothed quadrant on the rudder stock. This arrangement proved a complete success from the start, and was adopted as their standard by the Great Lakes Engineering Works, and has since been installed in practically all of the vessels built by this firm since that time.

When building the steamer St. Clair for the Northern Lakes Steamship Co.'s fleet in 1910, the Great Lakes Engineering Works made a further radical step by installing the above direct toothed gear in duplicate, that is, two steering engines were fitted on the fantail direct connected to the quadrant, each engine having a complete and independent transmission gear to the pilot house, and each gear having its own steering wheel. The method of changing over from one steering gear to the other was accomplished by means of a Chadburn signalling system from the pilot house to the engine room, where the engineer on watch, on receipt of the signal from the pilot house, instantly changed over the gears from one steering engine to the other by means of locked levers, situated at his hand on the starting platform in the engine room. This arrangement enabled the engineer to personally ascertain that the change from one steering gear to the other had been successfully made, and that the newly thrown in gear was working smoothly.

This duplicate gear was so successful in its operation that it has been fitted in several of the largest freighters built by the Great Lakes Engineering Works since that date. Among other vessels it has been fitted by them on the two largest American bulk freighters on the great lakes, the Col. Jas. M. Schoonmaker, and the William P. Snyder Jr., of the Shenango fleet, built at the Ecorse shipyard in 1911 and 1912.

Since the successful pioneering of this direct drive steering gear by the Great Lakes Engineering Works, other ship builders have fallen in line and have fitted it on their most recent boats. On the steamer W. D. Crawford, built by the American Ship Building Co., at Lorain in 1914, for the Hanna & Co.'s fleet, it was fitted in its single engine type. On the passenger steamer Noronic, of the Northern Navigation Co.'s fleet, built at Port Arthur last year, the American Ship Building Co. fitted this gear in its duplicate type, with some minor modifications, but involving the same essential principles as the gear fitted by the Great Lakes Engineering Works on the steamer St. Clair in 1910.

Ore Dock May 1

Statistics gathered by *The Marine Review* from the various dock managers at Lake Erie ports show that the amount of ore on Lake Erie docks on May 1, of the present year, was 6,092,303 gross tons, as against 5,920,157 tons in 1914, an increase of 172,146 tons.

The total rail shipments from Lake Erie ports to furnaces during the winter season (Dec. 1 to May 1) aggregate 2,315,602 tons, viz.:

	Tons.
On dock Lake Erie ports, Dec. 1, 1914	8,407,905
On dock May 1, 1915	6,092,303
By rail to furnaces, winter of 1914-15	2,315,602

Adding these winter shipments to 22,914,887 tons, the amount shipped to furnaces during the navigation season of 1914, gives 25,230,489 tons as the entire consumption of ore from Lake Erie ports during the year ending May 1, 1915, as against 39,089,319 tons for the year ending May 1, 1914, as against 37,437,269 tons for the year ending May 1, 1913, 26,428,799 tons for the year ending May 1, 1912, 36,636,692 tons for the year ending May 1, 1911, 33,599,913 tons for the year ending May 1, 1910, 20,524,523 tons for the year ending May 1, 1909, 31,692,446 tons for the year ending May 1, 1908, 30,099,769 tons for the year ending May 1, 1907, 28,984,358 tons for the year ending May 1, 1906, 20,057,070 tons for the year ending May 1, 1905, 18,739,995 tons for the year ending May 1, 1904, 21,905,251 tons for the year ending May 1, 1903; 17,216,065 tons for the year ending May 1, 1902, 14,465,260 tons for the year ending May 1, 1901, and 15,882,881 tons for the year ending May 1, 1900.

The following table gives the amount of ore on dock at the close of navigation last year and the opening this year:

Port.	May 1, 1915.	Dec. 1, 1914.
Buffalo	178,152	234,880
Erie	412,186	484,467
Conneaut	564,077	1,160,639
Ashtabula	1,963,233	2,749,315
Fairport	283,591	406,124
Cleveland	1,592,783	1,757,543
Lorain	377,550	548,097
Huron	462,917	483,769
Sandusky	2,471	2,471
Toledo	255,343	580,600
Total	6,092,303	8,407,905

Out of a total movement of 503,832 gross tons of ore during April, 136,224 tons went to Lake Erie ports, distributed as follows:

Port.	Gross Tons.
Buffalo	10,662
Erie	.....
Conneaut	31,599
Ashtabula	36,665
Fairport	11,066
Cleveland	37,654
Lorain	.....
Huron	8,578
Toledo	.....
Total	136,224

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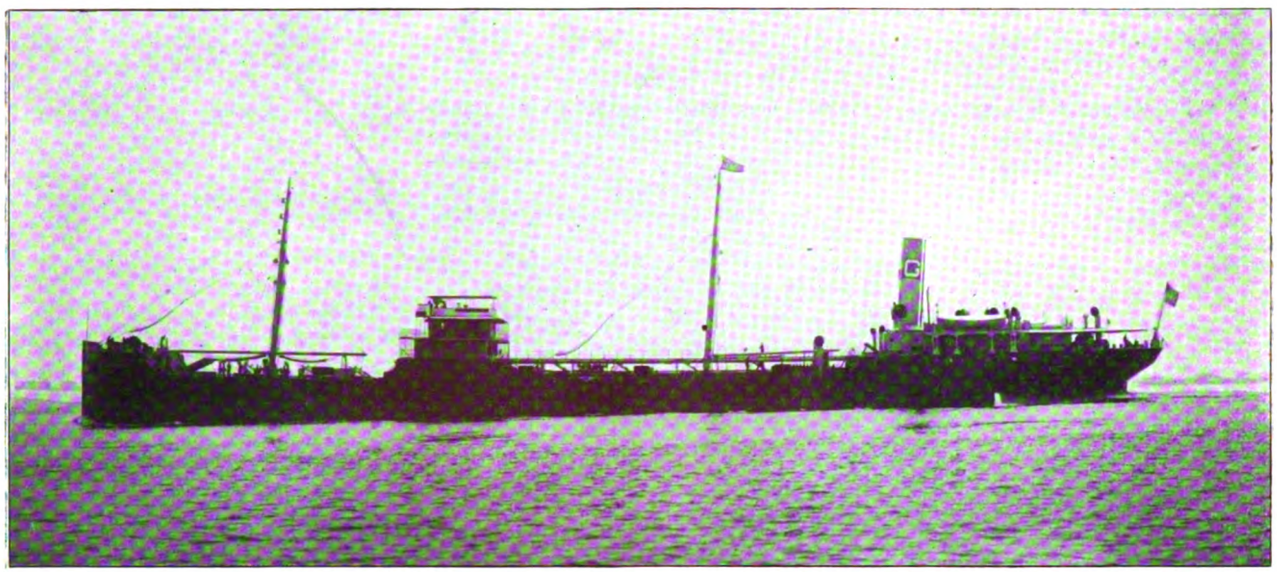
Tanker Gulfcoast on Trial Trip

The accompanying picture of the Gulfcoast, recently completed at the yard of the New York Ship Building Co., is practically a duplicate of her sister, the Gulflight, sunk in the Mediterranean by a German submarine. The Gulfcoast, like her sister, belongs to the Gulf Refining Co. of Pittsburgh, and is of the two-deck type with raised poop and boiler deck, while the expansion trunk is carried above the upper deck. Their dimensions are 406 feet 6 inches in length over all, 51 feet beam and 30 feet 3 inches deep. They have a carrying capacity of 2,285,000 gallons of oil in bulk. The propelling machinery located aft consists of triple-expansion engines having cylinders 27 inches, 45 inches and 75 inches in diameter by 48 inch stroke, supplied with steam from three single-ended Scotch boilers, 14 feet 8 inches diameter and 11 feet long.



STEAMER GULFCOAST ON TRIAL TRIP
Photo by New York Ship Building Co.

Opening of Lake Trade

More freight was moved on the Great Lakes during April than was expected. Quite a block of ore was sold in April which caused shippers to send out vessels earlier than was originally planned. The Interstate Commerce Commission ordered a reduction of 5 cents in the rail rate from the Mesabi range, making it 55 cents instead of 60. The rate is to take effect June 15, but as it is now operating to reduce shipments from the mines it is quite likely that the railroads will put it into effect at an earlier date. As to whom the reduction will accrue is a mooted question. The shippers obviously thought that they should get it, but some of the furnaces believe that they ought to get it, whereas the railroads themselves have always felt that a dock charge of five cents should be imposed for handling ore and are now talking of adding such a charge.

Stages of water have been unusually low since navigation opened and a number of vessels have touched bottom in the rivers. In a few cases it has been necessary to lighter in order to release them.

The price of fuel coal from dock was cut 10 cents a ton upon the opening of navigation. From lighters, however, it is the same as last year. Fuel coal from dock will therefore cost this year $2.55 a ton and from lighters $2.80.

Commerce of Lake Superior

The commerce of Lake Superior during April as measured by the Sault Ste. Marie canal was 1,434,735 net tons as against 774,520 tons for April, 1914, and 1,905,555 tons in April, 1913. The gain over last year is principally in grain and ore. The American canal carried 1,319,051 tons and the Canadian canal 115,684 tons. The American canal opened April 17 and the Canadian canal April 13. Following is the summary:

Articles	Total
East Bound	
Copper, short tons	5,749
Grain, bushels	6,151,055
Flour, barrels	305,370
Iron Ore, short tons	411,845
Lumber, M. ft. B. M.	5,548
Wheat, bushels	16,493,824
General Merchandise, short tons	10,812
Passengers, number	67
West Bound	
Coal, hard, short tons	130,111
Coal, soft, short tons	149,455
Manufactured Iron, short tons	8,580
Salt, barrels	50,937
General Merchandise, s ort tons	48,967
Passengers, number	113
Summary	
Vessel Passages, number	634
Registered Tonnage, net	1,233,845
Freight—	
East bound, short tons	1,090,077
West bound, short tons	344,658
Total Freight, short tons	1,434,735

McNab Cascade Boiler Circulator

The following vessels on the Great Lakes were installed with the McNab Cascade boiler circulator and fuel economizer prior to the opening of navigation:

John J. Barlum, six furnaces; Thomas Barlum, four furnaces; Albert E. Stewart, six furnaces; A. E. Nettleton, six furnaces; Matthew Andrews, six furnaces; Theo. H. Wickwire Jr., six furnaces, and William S. Mack, four furnaces.

Many other installations of the Cascade system are being made on the Atlantic and Pacific coasts, including repeat orders from the American-Hawaiian Steamship Co. for this installation to be made on their steamer Alaskan, twelve furnaces, and from the Bull-Insular Line on their steamer Millinocket, six furnaces.

The ship life preservers and the pillow life preservers manufactured by the Robinson-Roders Co., Newark, N. J., have just been officially adopted by the Canadian Steamboat Inspection Service after thorough tests. The Universal life belt made by this company will fit persons of any size and therefore covers the requirements of the various governments requiring life preservers for children. The Universal can be adjusted to a child just as readily as to an adult.

Thaddeus S. Volmer, 1422 Provident street, Cincinnati, O., has just issued a booklet on the Little Hercules bilge pump manufactured by him. It is made in several sizes and can be operated by foot or hand power and is quite useful for the smaller class of commercial vessels.

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Steamboat Inspection Rulings

The following are copies and excerpts from letters written during the month of April, 1915, wherein rulings have been handed down relative to the interpretation of certain of the Revised Statutes by the Steamboat Inspection Service:

The Bureau informed the supervising inspector of the First District, San Francisco, Cal., that manganese borates, oleic acid (turkey red oil), sodium sulphate (salt cake), and bychromate of potassium may be transported on steamers carrying passengers. Also that bronze powders may be transported on steamers carrying passengers provided they are packed in hermetically-sealed zinc-lined packages, or in packages properly lined with tin plate or terne plate. Thermit, however, which is aluminum powder mixed with certain metal oxides, and used for welding rails, repairing castings, etc., is a dangerous commodity, and shall not be transported on steamers carrying passengers.

Relating to the transportation on steamers carrying passengers of roofing cement manufactured by the General Roofing Mfg. Co., of New York, N. Y., you are informed that the said company having submitted to this bureau another sample of roofing cement, the bureau did on April 3, 1915, rule that roofing cement manufactured by the General Roofing Mfg. Co., having a flash point of not less than 239 degrees Fahr., and fire point of not less than 253.4 degrees Fahr., may be transported on steamers carrying passengers.

Referring to ruling of this bureau, dated July 8, 1914, published in the bureau's circular letter dated Aug. 1, 1914, in regard to the transportation of morganbrite polish, you are informed that under date of April 6, 1915, the bureau informed the local inspectors at Providence, R. I., that morganbrite polish having a flash and fire point of not less than 338 degrees Fahr., may be transported on steamers carrying passengers, and may be used as stores on passenger and pleasure steamers.

The bureau informed the supervising inspector of the First District, San Francisco, Cal., that cresol may be permitted as a deck load on steamers carrying passengers, providing it is packed according to quantity in iron drums or in watertight tin cans, which are enclosed in strong wooden cases.

Referring to the rulings of this bureau, dated April 11, 1911, to the Hamburg-American Line of New York, N. Y., published in bureau circular letter dated May 1, 1911, stating that pintsch gas shall not be transported on steamers carrying passengers, you are informed that under date of April 20, 1915, the bureau informed the Safety Car Heating & Lighting Co., Washington, D. C., that the solicitor of this department had handed down an opinion to the effect that the transportation of pintsch gas on steamers carrying passengers is not prohibited by Section 4472, R. S.

The Safety Car Heating & Lighting Co., Washington, D. C., having advised the bureau that pintsch gas is sometimes shipped under the trade name of isolite for use in suburban lighting, this bureau, under date of April 29, 1915, file No. 42631, advised the above-named company that isolite being the same as pintsch gas, its transportation on steamers carrying passengers is not prohibited by Section 4472, R. S.

The bureau informed the Standard Oil Co. of New Jersey, 26 Broadway, New York, N. Y., that Standard asphalt binder "A", asphalt flux, and pitch, of the same kind as samples that were submitted by the said company, may be transported on steamers carrying passengers.

During April the bureau approved the Kapok Neversink life jacket, manufactured by the American Life Saving Garment Co., 463 Commercial street, Boston, Mass., for use on motor boats not carrying passengers for hire when such life jackets contain sufficient kapok to sustain afloat for a continuous period of 24 hours an attached weight so arranged that whether the said weight be submerged or not, there shall be a direct downward gravitation pull upon such life jacket of at least 20 pounds, and when such life jackets are stamped with the words "Kapok Neversink Life Jacket, Manufactured by the American Life Saving Garment Co., Boston, Mass.".

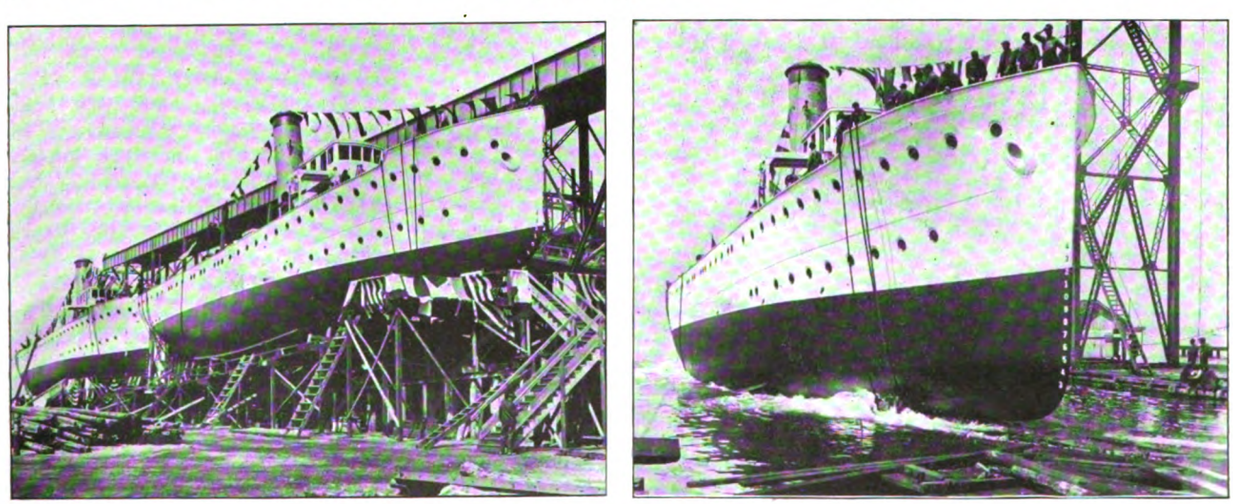
Coast Guard Cutters

The new coast guard cutters Tallapoosa and Ossipee were successfully launched at the Newport News yard May 1.

Miss Sally Fleming McAdoo, the 11-year-old daughter of the secretary of the treasury, was sponsor for the Ossipee, and Miss Mabel Hartwell, daughter of H. T. Hartwell, of Mobile, Ala., for the Tallapoosa.

The two cutters were authorized by congress in June, 1914, the Ossipee at a cost of $225,000 and the Tallapoosa at $250,000. The Tallapoosa will replace the old cutter Winona, with headquarters at Mobile, and the Ossipee replaces the cutter Woodbury, at Portland, Me.

The new vessels are practically duplicates, each being 165½ feet long over all 32 feet beam, 20¾ feet deep, and of about 900 tons normal displacement. Each will be armed with a battery of four standard navy 6-pounder rapid-fire rifles and have a steaming radius of about 5,000 miles. They were described in the December, 1914, *Marine Review*, when they were known simply as revenue cutters 26 and 27.



DOUBLE LAUNCHING AT NEWPORT NEWS—COAST GUARD CUTTERS OSSIPEE AND TALLAPOOSE TAKING THE WATER

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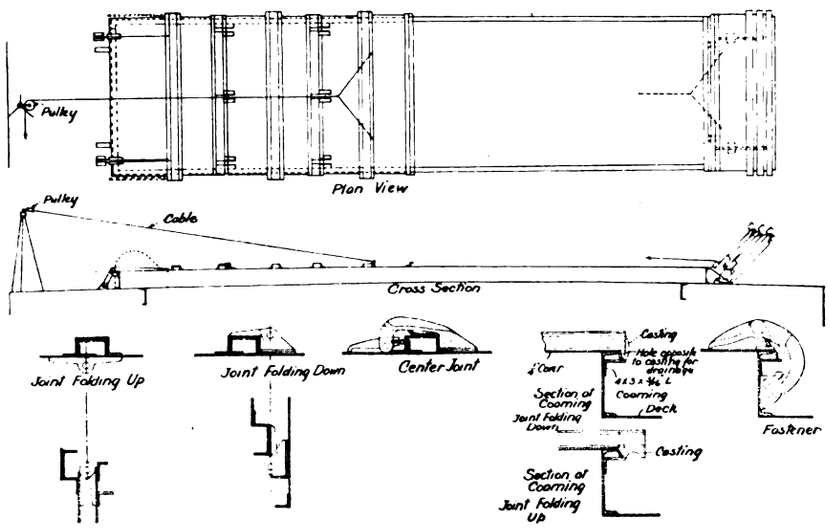
New Hatch Cover

Matthew Funder, of Fairport, and Capt. F. B. Chilson, of the steamer Charles O. Jenkins, of the Hutchinson fleet, have jointly patented a new form of hatch cover which they represent has a number of advantages over the present type of telescopic hatch cover. To make the present type watertight it is necessary to use tarpaulins. With the new type no tarpaulins are needed as the joints are protected by double channels overlapping on coaming and are absolutely watertight. The general design of the cover is completely illustrated in the accompanying drawings. The hatch cover consists of two primary parts consisting of wide and narrow sections, alternately arranged, as indicated by the numerals 5 and 6. The hatch sections are fitted along the longitudinal edges with interlocking hinges and are made rigid and watertight by the channel bars which stretch from coaming to coaming. While the covers are made of 12-pound plate they are represented to be as strong as 15-pound plate in the ordinary telescopic hatch. The covers are operated by wire cable and instead of being telescoped are practically stood up on end at the side of the hatch.



SECTIONAL DRAWING OF FUNDER HATCH COVER

April Lake Levels

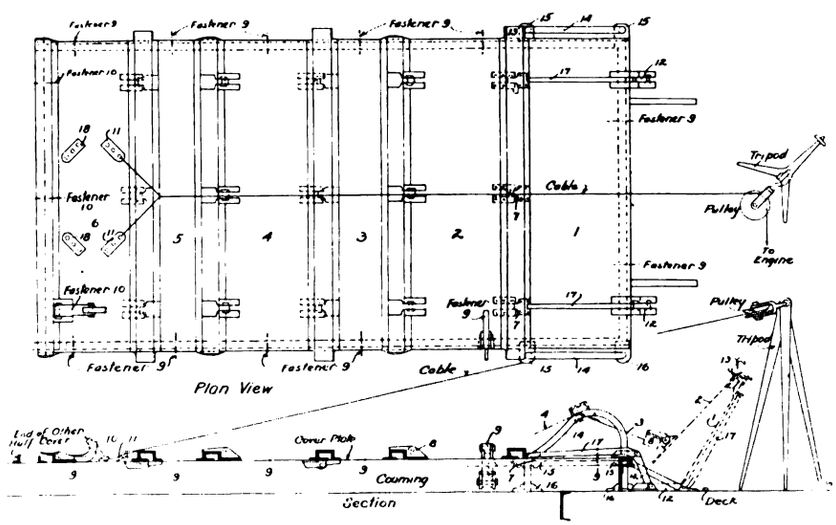
The United States Lake Survey reports the stages of the Great Lakes for the month of April, 1915, as follows:

Lake	Feet above mean sea level
Superior	601.34
Michigan-Huron	579.48
Erie	571.45
Ontario	245.04

Lake Superior is 0.16 foot lower than last month, 0.50 foot lower than a year ago, 0.30 foot below the average stage of April of the last ten years, 1.35 feet below the high stage of April, 1860, and 0.80 foot above the low stage of April, 1911. Average stages of the last ten years indicate that the May level will be 0.3 foot higher.

Lakes Michigan-Huron are 0.09 foot lower than last month, 0.60 foot lower than a year ago, 0.91 foot below the average stage of April of the last ten years, 3.75 feet below the high stage of April, 1886, and 0.26 foot above the low stage of April, 1896. Average stages of the last ten years indicate that the May level will be 0.3 foot higher.

Lake Erie is 0.08 foot higher than last month, 0.73 foot lower than a year ago, 0.97 foot below the average stage of April of the last ten years, 2.73 feet below the high stage of April, 1862, and 0.19 foot above the low stage of April, 1895. Average stages of the last ten years indicate that the May level will be 0.4 foot higher.



SECTIONAL DRAWING OF FUNDER HATCH COVER

Lake Ontario is 0.23 foot lower than last month, 1.71 feet lower than a year ago, 1.44 feet below the average stage of April of the last ten years, 3.39 feet below the high stage of April, 1886, and 0.20 foot above the low stage of April, 1872. Average stages of the last ten years indicate that the May level will be 0.4 foot higher.

The following bids were received at the bureau of light houses, department of commerce, Washington, D. C., and also at the office of the light house inspector, San Francisco, for constructing the steel light house tender Cedar.

Navy yard, Portsmouth, N. H., $280,294; time, 15 months.

Gas Engine & Power Co. & Charles L. Seabury & Co., Inc., Morris Heights, N. Y., $276,000; for omitting evaporating plant, etc., $274,000; time not stated.

Seattle Construction & Dry Dock Co., Seattle, Wash., $296,500; for omitting evaporating plant, etc., $293,560: time, 10 months; alternate bid for main engine and condenser on bidder's specifications, $290,000; on bidder's specifications omitting evaporating plant, etc., $287,700.

The annual meeting of the Canada Steamship Lines, Ltd., was held at the offices of the company in Montreal during the last week in March. The annual financial statement showed that the total revenue of the company was $6,585,810; the expenses were $5,657,773 and net earnings $928,036. After deducting for interest and reserves for depreciation the net loss for the year was $59,932. In the financial statement it was stated that the partial failure of the northwest crop and the consequent very low freight rates obtained in the fall made a serious impression on the company's earnings.

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The War and Shipping

British and German shipping has suffered considerably as a result of the war, that is the trading ships apart from men of war. The total German trading tonnage is about one-fourth that of the British and as the latter has the command of the sea, Great Britain has been able to inflict very considerable loss on her foe. At the commencement of December the results of 16 weeks of warfare have been ascertained to be as follows. The details given below show at a glance what the words holding the ocean highways really mean. The statement is limited to steamships of over 100 tons gross of which at the commencement of the war Great Britain possessed 10,123 of a total gross tonnage of 20,523,706 and Germany 2,090, aggregating 5,134,720 tons gross. The average tonnage of the British trading fleet is 2,027 tons, and of the German 2,450 tons, the Germans have therefore a relatively larger number of vessels of big tonnage. Briefly the present positions and respective losses have been as follows:

GREAT BRITAIN

	Total vessels.	Captured, detained at German ports.	Plying.
No. of trad'g vessels	10,123	195	9,928
Gross tonnage	20,523,706	587,635	19,936,071
Perc't. of No.	100	1.9	98.1
Perc. of ton..	100	2.9	97.1

GERMANY

No. of trad'g vessels	2,090	1,221	869
Gross tonnage	5,134,720	4,584,926	549,794
Perc't. of No.	100	58.4	41.6
Perc. of ton..	100	89.3	10.7

The following schedule gives particulars of the vessels captured or detained:

BRITISH

Captured	51
Detained in German ports.....	75
Help up in Baltic and Black Sea.....	71
Total	197

GERMAN

Captured	80
Detained in British or Allied ports.....	166
Seeking refuge in neutral ports.....	646
In German ports.....	329
Total	1,221

It will be noted that the whole of British ships not captured or detained, representing 98.1 per cent of the total and 97.1 per cent of the aggregate tonnage are keeping the seas. While of 869 German ships not captured or detained, only ten are known to be at sea. German ships over 500 tons not accounted for 125, steam trawlers not accounted for, 353; small coasters not accounted for 381. Total of these 869.

The Inter-Island Steamship Co. has purchased 35 acres of property fronting on the proposed Kalihi channel at Hawaii and will construct a complete plant consisting of ships, warehouses and docks. The cost of the property was $340,000.

Albert Lloyd Hopkins

Among the persons who lost their lives in the sinking of the Cunard liner Lusitania by a German submarine off the coast of Ireland, was Albert Lloyd Hopkins, president of the Newport News Ship Building & Dry Dock Co. His loss is very keenly felt throughout the whole shipbuilding industry. His friends were legion and no finer personality followed the profession.

Mr. Hopkins was born Sept. 7, 1871, at Glens Falls, N. Y. His early life was spent at Glens Falls and in Troy, N. Y. In 1888 he entered the Rensselaer Polytechnic Institute in the course of civil engineering and graduated with high honors in 1892. The director of the institute said of him:

ALBERT LLOYD HOPKINS

"About 10 per cent of those who apply are admitted to the institute. About 20 per cent of those admitted are graduated and among these once in a while we find a Hopkins."

Shortly after his graduation Mr. Hopkins was appointed to a position in the bureau of construction and repair, navy department, Washington, and about 18 months later was transferred to Newport News as a member of the staff of Naval Constructor J. J. Woodward. In the summer of 1897, Mr. Hopkins was transferred from Naval Constructor Woodward's office and assigned to the graduate school of naval architecture in the United States Naval Academy, at which place he was an instructor and lecturer on naval architecture and ship construction. At the outbreak of the Spanish war in April, 1898, Mr. Hopkins was assigned to the naval station at Key West, Fla., the nearest station to the blockading fleet operating in Cuban waters. While at Key West, Mr. Hopkins was in charge of all the construction and repair work done for the fleet at that station. He was also active in improving the efficiency of the plant, installing much new equipment and rendering it capable of serving as a repair station for naval purposes.

It was while engaged in this work that Mr. Hopkins received from W. A. Post, general superintendent of the shipyard, an offer to return to Newport News. He accepted the position of personal assistant to Mr. Post in August, 1898. In this capacity Mr. Hopkins achieved a most enviable reputation and when Mr. Post was made general manager of the company in 1905, Mr. Hopkins was appointed assistant general manager and in 1911 when Mr. Post succeeded to the presidency on the death of C. B. Orcutt, Mr. Hopkins was made manager. Upon the death of Mr. Post in February, 1912, Mr. Hopkins was elected vice president and became the chief executive officer of the company with headquarters in New York. This opened up an entirely new line of work as it carried him among bankers, lawyers and men of large affairs, but he was more than equal to it and the impression that he created was deep and lasting. He was made president of the company in March, 1914.

Mr. Hopkins was a member of the American Society of Civil Engineers, American Society of Naval Engineers, Society of Naval Architects and Marine Engineers, and the American Academy of Political and Social Science.

In June, 1906, Mr. Hopkins was married to Miss May Davies, of Chase City, Va., who with her daughter, May Davies Hopkins, survives him. Mr. Hopkins is also survived by his mother, of Glens Falls, N. Y., and his brother, Charles E. Hopkins, of Hudson, N. Y. His father, Stephen De Forrest Hopkins, died at his home in Glens Falls, May 1, 1915, only a few hours after his son sailed on his ill-fated voyage.

Cramp's, Philadelphia, have just received orders for the construction of three new steamships, one a 10,000-ton oil tanker from the Huestica Oil Co., of New York, and two general cargo carriers for W. R. Grace & Co., New York, to ply in the Atlantic-Pacific trade via the Panama canal.

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Automatic Lighting System

As indicated in the May *Marine Review*, all steamers carrying passengers will be compelled to carry an auxiliary lighting system located above the deep load line, sufficient to light the steamer to enable passengers and crew to find their way to the exits in case of the failure of the main lighting system. Provision is also made for the carrying of gasoline for this purpose under certain restrictions on board passenger and freight steamers.

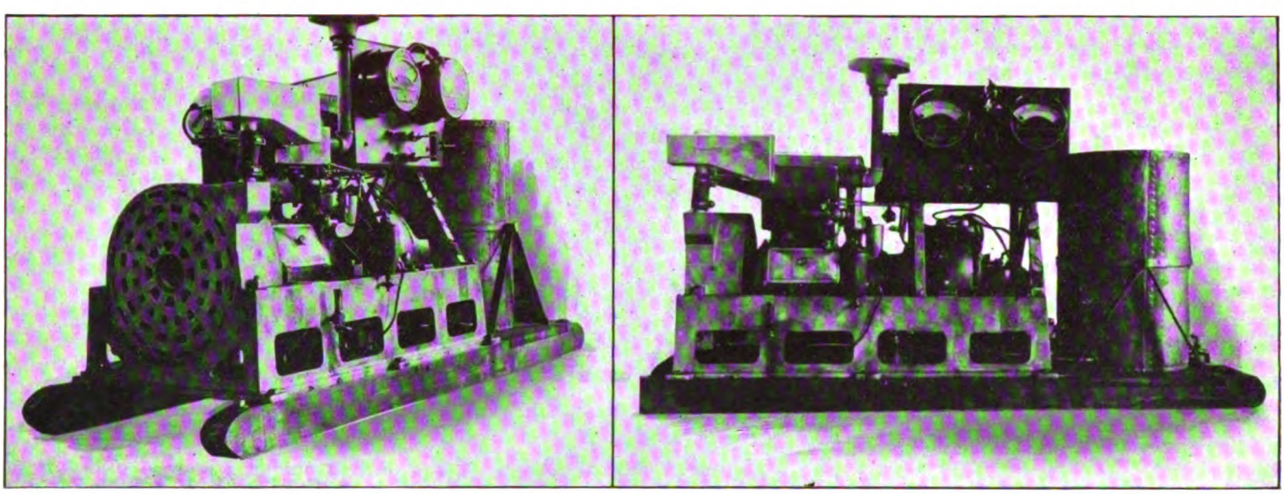
There is obviously open here a very wide market for auxiliary lighting equipment. In this connection attention is directed to the automatic lighting system designed by the Matthews Boat Co., Port Clinton, O.

The plant consists of a two-cylinder four-cycle motor direct connected to a generator, all on a common base. The general assembly of the equipment is very attractive as it is compact, self-contained and easily portable. The engine is of the latest design with overhead valves, cam over top of cylinders, automatic oiling system, water cooling taken care of by means of a cast radiator built over the flywheel, and a draft of air drawn through the radiator by fan blades, which form the spokes for flywheel casting. The ignition equipment consists of a Bosch magneto built into the machine, with high-tension plug.

The generator is a two kilowatt equipment of General Electric make. The Schebler carburetor is used, and in connection with it is an electric governor which automatically controls the speed of the engine by means of the carburetor throttle.

The equipment covers the exact requirements for use on steamers. On smaller vessels, the one kilowatt house-lighting plant which may be of the automatic type, will also be found satisfactory. This plant has a capacity of 50 20-watt 16-candlepower lamps, which would take care of the passageways of practically any of the smaller passenger vessels. The factory has already equipped several small steamers between 100 and 150 feet, with these automatic plants, for lighting the entire boat.

The feature that is attractive on these automatic plants is that the batteries are kept to full charge without attention. The plant automatically starts up when the batteries have been discharged 15 per cent, and automatically cuts out when this charge has been put back, with a slight over-charge. A heavy load on the set will also start the plant working.



MARINE LIGHTING PLANT AS MANUFACTURED BY THE MATTHEWS BOAT CO., WHICH WILL SERVE ADMIRABLY ABOARD SHIP AS AN AUXILIARY LIGHT EQUIPMENT

British Steamship Profits

While the International Mercantile Marine Co. has apparently been unable to pay the interest on its 4½ per cent debenture stock, the directors of the Cunard Steamship Co. are able to announce record profits. The directors state that, subject to the completion of the audit, the profits for 1914, including £130,378 ($651,890) brought forward amount to £1,417,326 ($7,086,630), as compared with £1,276,795 ($6,383,975) in 1913, £88,964 being brought forward from 1912. After debiting the income tax and reserving £550,472 ($2,752,360) for depreciation, against £443,637 ($2,218,185), transferring £350,000 ($1,500,000) to the repairs and renewal account, and £68,949 ($344,745) to the insurance fund, it is proposed to recommend the payment of a dividend of 10 per cent and a bonus of 10 per cent, against 10 per cent in 1913 and 1912, 7½ per cent in 1911, 5 per cent in 1910 and none in 1909, leaving £141,996 ($509,980) to carry forward.

While the results of the Cunard company's operations last year, including five full months of war conditions, are held to be encouraging in local shipping circles, a statement which appeared in the London *Daily Telegraph* about a fortnight ago to the effect that British shipowners are making fortunes at the rate of £100,000 ($500,000) and over a month since the war began is regarded as an exaggeration.

Shipping interests in New York, who are in receipt of reports which have very recently been issued for 1914 by at least a score of the more important British cargo carrying steamship companies, assert that the statement as to "fortunes being reaped" by the English ship owners every month since the war has been in progress is not borne out. Examination of the detailed reports made by British cargo carrying steamship companies, covering 1914 as a whole, shows a widely different state of affairs as applying to some as against others. A few of the larger cargo carrying lines have made fair but not more than normal profits, while many others are comparatively behind.

Since the beginning of the current calendar year, moreover, it is learned, profits have only been large for those British owners who have been able to take advantage of the prevailing high freight rates. The fact that a large number of British cargo boats have been requisitioned by the admiralty, in which service profits are strictly limited, the rates paid being only about one-half the current general market rates, shipping authorities here explain, will prove disappointing to some British shipping shareholders.

Analyzing the reports issued by 20 British cargo vessel operating companies, most of which cover five or six months of the war, it is learned that in every instance the profits are lower than last year.

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Valves and Valve Gears

Description of the Methods Employed in Four-Stroke Engines in Controlling the Working Gas by Means of Valve Mechanism

By E. P. Culver

SINCE the satisfactory performance of any reciprocating engine depends very largely upon the proper functioning of its valves and their actuating gear, it is of the utmost importance that this vital feature of design be determined only after the completion of a careful study and comparison of both the theory and the practice of all available types. In the average internal-combustion engine, the accessories of which are adjusted to supply proper carburation and ignition,

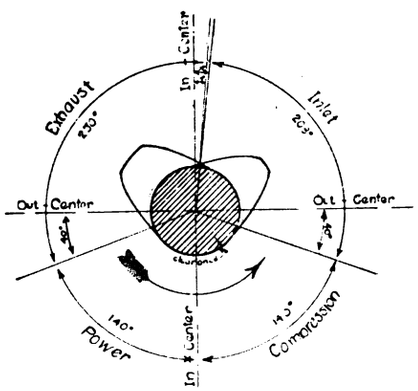


FIG. 1—DIAGRAM SHOWING RELATIVE CAM SHAPES AND POSITIONS IN THE OPERATION OF A FOUR-STROKE ENGINE

the all important characteristics of economy, power, speed and silence are defined by the degree of efficiency with which the working gas is controlled by the valve mechanism.

Because an internal-combustion engine drives its mechanical power through the liberation of the thermal energy contained in the working hydro-carbon, obviously as little as possible of the heat developed should be wasted; consequently the less area presented by the cool cylinder walls, the less will be the thermal loss through radiation to the cooling water. Thus, in the light of the foregoing, it is apparent that valve gears must be judged from the standpoint not only of their mechanical excellence, but also of their effect upon the thermal efficiency of the machine. Unfortunately both of these essentials cannot be satisfied to the maximum degree at the same time, for the valve gear of highest mechanical excellence requires exposing a relatively large area of cooling walls, while those types permitting the best-shaped combustion chamber (hemispherical) are complicated, subject to wear and noisy. Thus the best engine for any given service is the compromise in which these characteristics of most importance in the required service are involved to the greatest degree.

All gasoline engines may be classified as of either the poppet-valve type or the non-poppet, but as the former is practically the only type to be found in the marine field today, the various forms of rotary and sleeve valves will not be considered in this article.

The Poppet Valve Type

A poppet valve consists essentially of a disc which normally rests on top of, and completely covers, an outlet aperture; when the valve is to be opened, this disc is raised from its seat by a suitable mechanism, thus permitting free outlet through the before-mentioned aperture. To insure freedom from leakage in the poppet valve, the valve or disc usually has a bevelled edge, which corresponds to the similarly bevelled

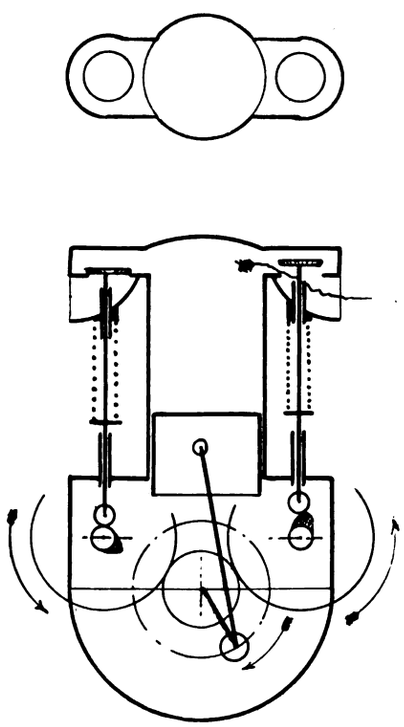
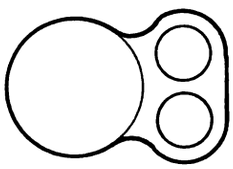


FIG. 2—T-HEAD TYPE WITH INLET AND EXHAUST VALVES AT OPPOSITE SIDES OF THE COMBUSTION CHAMBER

edge of the outlet hole, or valve seat. Although the bevelled seat is the most common type, some designers claim that as the continued hammering of the valve onto its seat tends to batter the valve out of shape, a flat-seated valve



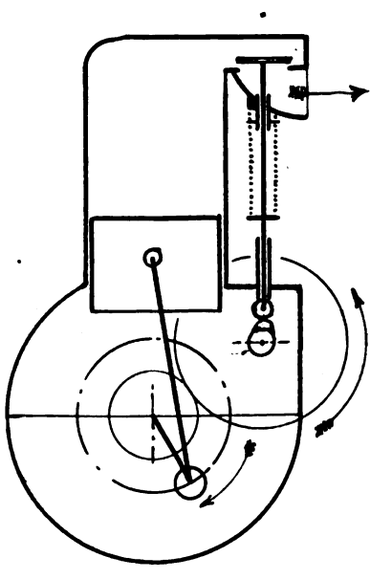


FIG. 3—SHOWING THE L-HEAD TYPE AT WHICH BOTH INLET AND EXHAUST VALVES ARE PLACED SIDE BY SIDE AND ARE OPERATED BY SINGLE CAM SHAFT

requires less-frequent grinding to maintain its gas-tightness.

In all events, it is desirable that all poppet valves be made of sufficient diameter to provide adequate escape areas with the smallest valve lift practical, so that by reducing the distance through which the valve falls to its seat, the valve life will be increased and much less noise will result. Invariably the opening and closing of poppet valves is accomplished by providing the valve proper with a stem upon which a spiral spring acts to hold the valve to its seat. When the valve is to be opened, a cam rolls under the

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valve stem and, overcoming the spring tension, raises the valve off its seat. As the cam recedes from under the valve stem, the valve spring returns the valve to its seat again.

Smooth Valve Action Demanded

To reduce the noise and wear between the cam and the valve stem, usually a pushrod with a roller is interposed. As silence of operation is greatly to be desired in the modern marine engine, especial attention is given to designing the cams so as to reduce their noise to a minimum by making their contours no more abrupt than is necessary for good valve opening; in fact, the tendency is to smooth out the cams even at the expense of the best theoretical openings, if it is found that wear and noise are thereby materially reduced. One of the most recently designed motors is provided with an "oil-silencer", an arrangement whereby the cams are completely submerged in oil, thus deadening the noise attending their operation and insuring thorough lubrication.

As is implied from its name, the four-stroke motor requires four piston-strokes to accomplish its cycle of: Inlet, compression, explosion, exhaust; from which it is evident that since a cam is required to open its valve but once in every two revolutions of the crankshaft, the latter drives the crankshaft at one-half its own speed, usually through the agency of 2:1 gears. As these are apt to grow noisy, this is guarded against in approved practice by designing the gears with a rawhide pinion or with spiral-cut teeth. A third efficient method, particularly adapted for use where the shaft centers are farther apart than could be conveniently bridged by but two gears of moderate radius, employs the "silent chain". However driven, the camshaft may be carried in either plain or ball bearings. As the splash from the cranks afford ample lubrication inside the crankcase, plain bearings give entire satisfaction; nevertheless a number of designers prefer to reduce friction slightly by the use of ball bearings. The stresses on the camshaft being relatively light, either type gives good service.

Most high-speed internal-combustion engines being of substantially similar construction as regards their elementary working members, but in many cases varying widely as regards their valve arrangement, this latter affords a convenient and lucid means of classification.

As during the suction stroke of the engine-piston, the pressure within the cylinder is lowered below that of the atmosphere, in early machines the inlet valves often were merely automatic spring-seated check valves; but increased piston speeds have shown that the action of such automatic valves is too

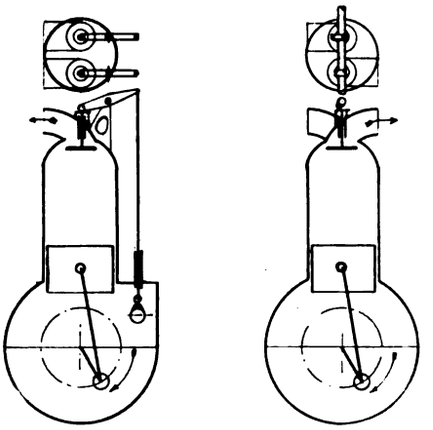

FIG. 4—TWO IN-HEAD TYPES IN WHICH THE VALVES OPEN DIRECTLY INTO THE CYLINDER ITSELF. (*A*) SHOWS THE ROCKER ARM WHILE (*B*) CARRIES THE CAM SHAFT ABOVE THE CYLINDERS

uncertain and sluggish, and much fuller fuel charges are obtainable with a positive, mechanically-operated inlet.

Replacement of Parts

To facilitate manufacture and the replacement of parts in the majority of high-speed engines the valves, valve-springs, and tappets of the inlet are duplicates of those of the exhaust, and thus are perfectly interchangeable therewith; but from this it must not be inferred that the respective cams also are similar, for although present-day practice favors equal lifts for the two valves, their times of opening and closing are worked out independently. Fig. 1 gives an idea of relative cam shapes and positions.

One of the earliest and most widely

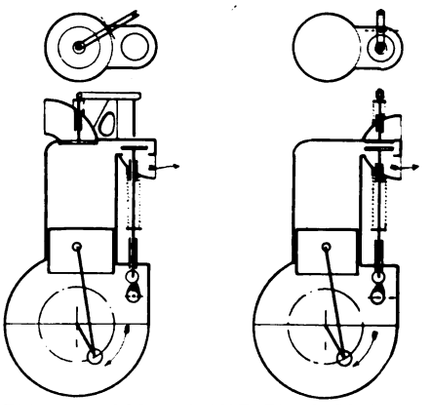

FIG. 5—A COMPROMISE TYPE COMBINING FEATURES OF T AND L-HEAD ENGINES. HIGH EFFICIENCY IS SECURED THOUGH MECHANICAL DIFFICULTIES ARE SOMETIMES ENCOUNTERED

used types of marine engine is the so-called "T"-head (Fig. 2), in which the inlet and exhaust valves are placed in pockets at opposite sides of the combustion chamber, and each has its own individual set of camshaft, driving gears, etc. As these two valve pockets involve a combustion chamber that exposes to the charge the maximum area of detrimental cooling walls, let us see why the "T"-head has been adapted by some of the most reputable manufacturers of marine engines with great success.

Valve Gear Wear Negligible

It is a significant fact that some of the highest-grade marine engines of today are of this type, the particular advantages of this arrangement being: Mechanical excellence, balanced appearance, effective gas distribution, and long valve life. Mechanical excellence is attained because in this arrangement valve gear wear is negligible, the valve stems receiving their motion directly from cams on the camshaft located in the well-oiled crankcase. This feature is of the utmost importance in marine work, since this service—unlike that imposed in automobile usage—requires that the engine shall stand up under continuous full load for extended periods of time without developing undue wear, consequent noise, and erratic valve-timing. If covers are provided for the valve stems, the whole gear is entirely enclosed, affording a very close approach to silence. As the valves, valve gear, and manifolds of the inlet and the exhaust are on opposite sides of the cylinders, the engine may be of a symmetrical design presenting a well-balanced appearance quite pleasing to the eye.

The "T"-head machine offers also the important advantage of effective gas distribution, for many high-speed motors of this type are so designed that the inlet valve starts to open about five degrees before the exhaust closes, the inertia of the outrushing exhaust produces a scavenging action that tends to suck out the remaining burnt gas and draw in the fresh charge. The inlet and exhaust valves being in diametrically opposite sides of the combustion chamber, the fresh incoming charge is less apt to become contaminated by mixing with the unexpelled inert gas predominating in the exhaust pocket, so that positive ignition under all circumstances may be insured by locating the spark-plug in the inlet pocket where it is surrounded by the most-highly explosive mixture.

In designs in which the inlet and exhaust valves are in close proximity, it is claimed that as they are swept alternately by the cool incoming charge and by the hot exhaust, their being maintained in a state of continued fluctuation by expansion and contraction prevents them from ever quite fitting their seats tightly. Since in the "T"-

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head the valves are swept by gas of relatively constant temperature, a state of equilibrium of temperature is possible between the valve and its seat, resulting in less variation of shape and theoretically a tighter valve.

It seems to me highly probable, however, that in avoiding the above phenomenon by removing the exhaust valve from the cooling influence of the incoming charge, there is introduced the more serious liability of excessive heating of the exhaust valve, with attendant warping and pitting. The main disadvantages of the "T"-head motor are its greater first-cost over other types due to the duplication of camshafts and their driving gears, etc., and to the lower thermal efficiency due to the comparatively large area of the cooling walls presented by the combustion chamber.

L-Head Cheaper and More Compact

The disadvantages of high cost and low cost thermal efficiency are partly overcome in the so-called "L"-head type of motor (Fig. 3), in which both the inlet and the exhaust valves are placed side by side in the same pocket, permitting both to be actuated from one and the same camshaft. As the valve motion is imparted from the cams to the valves in the same manner as in the "T"-head, the only mechanical superiority over the latter type is that due to the simplification afforded by the elimination of one camshaft and its driving gear. This simplification, together with the simplification of the cylinder design, materially reduces the cost of manufacture, secures compactness, facilitates the application of efficient valve stem covers, and aids in attaining a quietly-running engine. The lesser area of cooling walls involved in the "L"-head combustion chamber increases the theoretical thermal efficiency of the design; which, other things being equal, has the highly desirable effect of decreasing fuel consumption. As the effects of placing the inlet and the exhaust valves in close proximity have already been discussed in detail, at this point it is only necessary to note that in the "L"-head arrangement a desirable cooling effect is exerted upon the exhaust valve although this is accomplished at the expense of possibly producing slight irregularities in the expansion of the valve.

The "In-head" type (Fig 4*a*) was evolved to reduce still further the area exposed by the cooling walls of the combustion chamber, and to permit of the valves opening directly into the cylinder itself. Due to the ease with which a cylinder of this sort may be changed and exhausted, it is possible at high speeds for it to receive from 20 to 30 per cent fuller explosive charge than could be handled in the more tortuous "T"-head type, thus affording excellent power and speed results. But as the cam thrust usually is transmitted to the valve stem by means of exposed rocker arms, the pivots in the latter are apt to develop sufficient lost motion to be noisy and materially to affect the valve timing.

For these reasons the "in-head" type

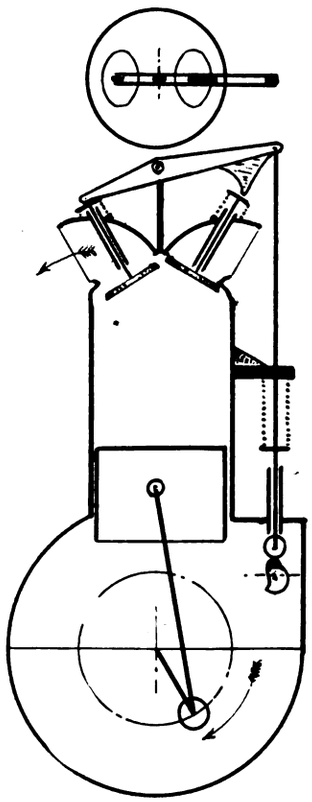

FIG. 6—SHOWS A DESIGN OFFERING THE LARGEST AND MOST DIRECT VALVE OPENING AND THE SMALLEST COOLING AREA. IT IS NOISY AND EXPENSIVE BUT GIVES MAXIMUM EFFICIENCY WHEN PROPERLY CONSTRUCTED

is most adapted to racing engines, in which the maximum power output for a given weight is of paramount importance, and with the expert attention and adjustment that a racing machine is usually accorded, there is little chance for trouble to develop in the valve gear. In fact, if the rocker arms are of proper dimensions and are provided with small roller bearings at the pushrod end and at the fulcrum—expedients seldom taken—this type of valve gear would be admirably adapted to branches of marine service other than racing.

The only practical method of producing an "in-head" machine in which the rocker arms are eliminated involves a camshaft located above the cylinders and actuating the valve stems directly (4*b*). As the inertia to be overcome in such a gear is very slight—only that of the valve and its short stem—a snappy valve-motion is easily obtained at high-speeds; but since considerable ingenuity is required to provide the same satisfactory drive, housing and lubrication for an overhead camshaft as is afforded by locating it within the crankcase, this design is of comparatively recent development except in several instances in which it has been incorporated in the design of remarkably efficient high-speed marine motors on the continent.

Since the only forces that must be overcome in opening the inlet valve are those due to its inertia and to the tension of its seating-spring, operating the inlet valve by a rocker arm or other indirect means entails no very considerable wear; but as the exhaust valve must be opened against considerable pressure (eg., 50 pounds per square inch) of the partially expanded working gas, its gear should be adapted to more severe stresses.

A Compromise Type With Distinct Features

A compromise type (Fig 5*a*), by recognizing this difference of stresses to which the respective valve gears are subjected, strives to combine as far as possible the advantages of the previously-considered types by locating a very large rocker-operated inlet valve in the head, and a direct-operated exhaust valve in a side pocket. The result is a motor not quite the mechanical equal of the "T" or "L"-head, but their superior as regards thermal efficiency and gas distribution. In (5*b*) is shown the inlet opening into the top of the pocket, directly above the exhaust valve—an arrangement that in large medium-speed motors is preferable to (*a*) because the valves are more easily inspected, and the impingement of the cool inlet materially aids in cooling a large exhaust valve. As this type has long been employed by one of the most reputable makers of high duty and speed engines ranging up to several hundred horsepower, it is of proven merit.

Naturally the engine best suited to high speeds is the one offering the largest and most direct valve openings into a hemispherical combustion chamber—this shape presenting the smallest cooling area of any for a given volumetric capacity. How these requirements may be pretty well met in practice is shown in Fig. 6.

Due to the shape of the combustion chamber, the valves opening into it must be set at an angle (usually 20 degrees or more from the horizontal),

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thus requiring for their proper actuation a valve gear of considerable interest. Normally each valve is held to its seat by a spring, the tension of which is overcome at the time of valve-opening by the depression of an overhead rocker arm, which latter receives its motion from a long push rod, which a strong spring-tension causes to ride on a peculiarly shaped cam in the crankcase. When a hump on the cam rolls under the push rod extending to the rocker arm, the free end of the latter depresses the exhaust valve stem; but after the completion of the exhaust stroke the pressure of the rod-spring causes the rod to fall into a hollow in the cam, and the inlet valve stem is depressed. Continued rotation of the cam raises the rod to its neutral position in which neither valve is depressed.

Although this valve gear comprises but one rocker arm, push rod, and cam, per cylinder, there are two objections to its use: The exposed gear wears relatively fast; and unless the tension of the spring acting on the pushrod is so great that it results in considerable power, absorption, wear, and noise, there is no assurance that at high speeds the cam contour will be followed closely enough to secure correct valve timing. For these reasons this gear is best adapted to service where noise and mechanical complication are less important than maximum power for a given cylinder displacement, and even here it is doubtful if the slight added efficiency resulting when the gear is in perfect adjustment justifies the undersirable mechanical features involved. Incidentally it is interesting to note that this gear was used on the motors of the famous Dixie III and Dixie IV.

Water-Cooling Necessary in Marine Service

Due to the severe conditions of continuous full load imposed in marine service, unless the valve seats are directly water-cooled the valves are apt to overheat sufficiently to pit and warp. Invariably "L"-head and "T"-head motors have this direct cooling; but this cannot always be said of the common type of "in-head" motor, in which the valves are placed in "cages" to facilitate their removal for purposes of grinding or inspection. A construction adapted to marine service locates the valve directly in the amply cooled detachable cylinder heads, where they are subjected to more moderate temperatures.

To secure a larger valve opening than it is practical to obtain by a mere increase in valve size, each cylinder may be provided with two inlet valves and two exhaust valves. The advantages of this duplication over a mere increase of diameter are several: A cylinder head will contain four valves of nearly as great diameter as would be afforded by but two valves; as valve capacities increase in *direct* ratio to their circumstances and hence to their diameters, while their areas increase as the *square* of their diameters, the opening of two duplicate valves absorbs but half the power that would be required to open an equivalent single valve; and large valves overheat and warp very much more than do smaller valves.

Although at the present time the use of duplicate valves is confined to automobile racing motors, in view of the remarkably high efficiency and speed shown by them in this field it is highly probable that this type will come into prominence next season in the power boat classics.

In conclusion, it should be borne in mind that no one type of valve gear is best for all uses, but that each type has certain characteristics that adapt it to some particular variety of marine service.

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THE MARINE REVIEW

Vol. 45 Cleveland-New York No. 7
July 1915

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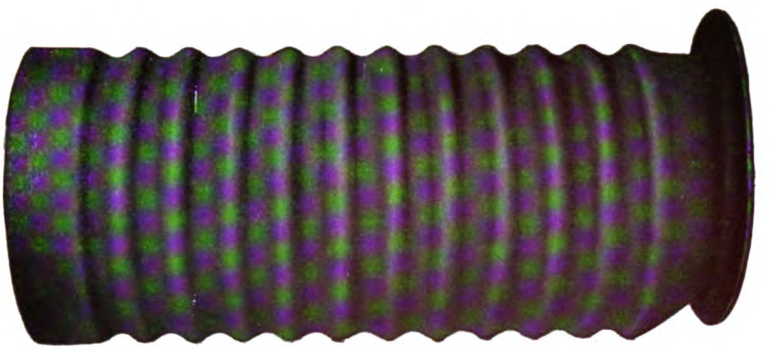

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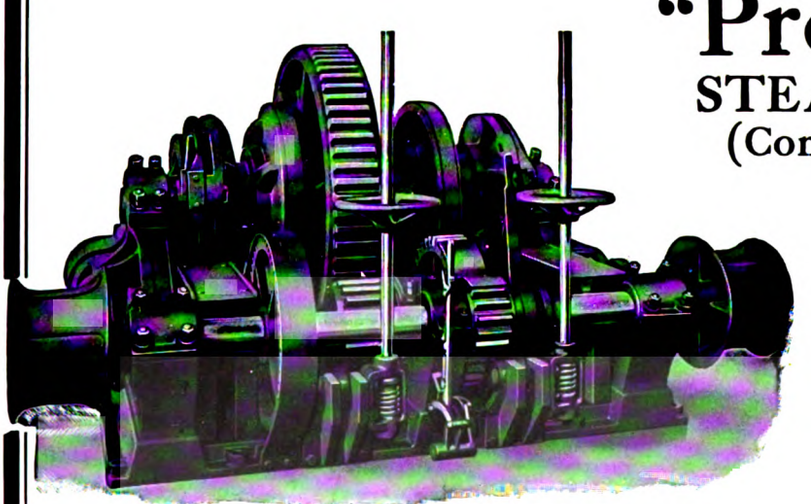

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